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The Production of High Grade Colorless Glass in Tank Furnaces

By George O. Smith*

Until recent years it was considered almost impossible to make anything but an inferior grade of glass in tank furnaces, both as to the quality and the color. Pot glass was always vastly superior to tank glass. Manganese dioxide was first used as the decolorizing agent, and while it produced colorless or nearly colorless glass in some instances, at times the glass would be green, pink, yellow, or brownish, according to the state of oxidation of the manganese, the amount of manganese used, the temperature of the furnace, and the flame conditions. Since selenium was introduced as a decolorizer in the manufacture of tank glass, much more satisfactory results have been obtained in producing flint glass in tanks. Selenium and selenium compounds are very much less sensitive to furnace and temperature conditions than manganese is. The amount of selenium necessary varies very little in comparison with manganese. While it may require from five to twenty pounds of manganese to a ton of sand, only from one to two ounces of selenium is necessary to produce a colorless glass.

Selenium can be used very successfully as a decolorizer for flint glass in tanks, but there are several factors which are very important in ascertaining the amount necessary under different conditions, namely:

1—Batch Making Materials in Use.
2—Kind of Fuel Used.
3—Size of Tank.
4—Temperature of Tank.
5—Cullet.

1—Batch Materials. The chief impurity in batch materials is iron which occurs as the oxide or as metallic iron. Titanium may be present as an impurity in the sand. Iron and iron compounds impart a greenish, a yellowish-green or a bluish-green tinge to the glass, depending upon the state of oxidation of the iron and the composition of the glass. The function of the selenium is to produce a pink or reddish tinge, which is complementary to the green tint caused by the iron, and so produces a colorless or nearly colorless glass. The lower the percentage of iron present, the less the amount of decolorizer required, and the more satisfactory are the results obtained. Titanium may cause a yellow-green tinge in the glass, but the amount present in a good grade of sand is usually negligible. Organic matter may occur in the sand or in the lime, especially if raw lime is used, and, if present in any great amount, will tend to cause a brownish or dark-colored glass unless some niter is used. If too much niter is used the selenium will be oxidized, and the glass will be greenish. Burnt lime or hydrated lime usually gives more satisfactory results than raw lime, which is probably due to the large amount of gas (carbon dioxide) evolved when raw lime is used which may mechanically cause some of the selenium to be carried off. On the other hand, the use of raw lime is an aid in plaining the glass, on account of the agitation it causes when it decomposes. Arsenic must be used as a refining or plaining agent with selenium, as antimony, if used in appreciable quantity, will tend to produce a dark color to the glass. A small amount of salt cake can be used, but if more than that is used, a straw-yellow glass will result. A small amount of cobalt is used to neutralize the slight yellow tinge caused by the slight excess of selenium required to overcome the green tinge caused by the iron in the glass.

2—Kind of Fuel Used. Selenium acts most efficiently when the tank condition is neutral or slightly reducing. A gas fire is usually less oxidizing than an oil fire, and for this reason less selenium is required in a gas fired tank than in a tank where oil is used as the fuel. Under reducing conditions selenium glass tends to become pink, and when there is an excess of air, the selenium is oxidized, and the glass becomes greenish. It follows that to obtain uniform results in the color of glass, a large excess of air or of fuel must be avoided. In a gas fired tank the furnace conditions change every time the fire is reversed, and it is more difficult to obtain the same tint in the glass from day to day than in oil-fired tank where the flame conditions are more constant.

3—Size of Tank. Usually a large tank requires more selenium than a smaller one, but under certain conditions the

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reverse may be true. However, this is a matter to be determined by personal observation.

4—TEMPERATURE OF TANK. Selenium glass becomes pink or reddish upon reheating to a high temperature, and for that reason less selenium is required in a tank where high temperatures are maintained. To obtain uniform results in the color of the glass, it is very essential that a wide variation in temperature be avoided. After ware made from selenium glass is put into the lehr, it may become pink in passing through the lehr if the temperature is excessively high. Milk bottle manufacturers desire a slight pink in their bottles, and some of them obtain this effect by running their lehrs at a high temperature.

5—CULLET. Manganese cullet may be used with selenium batch, but allowance must be made for the fact that manganese glass becomes green on remelting, and more selenium must be used when manganese cullet is present. When the cullet contains considerable manganese, or where much manganese cullet is used, experience proves that difficulty will be encountered in producing the desired tint in the glass.

Selenium may be used in various forms, such as the metal, as barium selenide, as sodium selenite, as a mechanical mixture with arsenic or other material, or as one of the several decolorizers on the market. The most important consideration is that the selenium content of the mixture or compound employed is constant. The selenium should not contain more than two-tenths of one percent of iron or copper if satisfactory results are to be obtained.

If the above conditions are fulfilled as nearly as possible, glass that is equal to pot glass, can be made in a tank, and in some instances I have seen tank glass superior to the pot glass that some factories produce. Some manufacturers are troubled with cords and waves in their tank glass, but this difficulty will not be experienced if the proper batch is used and the correct proportions of batch and cullet are used, and if the glass is allowed the proper amount of refining space, and sufficient time to plain and become homogeneous before it flows from the melting end into the working end.

The Effect of Salt-cake in Soda-Lime Batches in Corroding Fireclay Refractory Materials*

BY EDITH M. FIRTH, B.SC., F. W. HODKIN, B.SC., and PROF. W. E. S. TURNER, D.SC.

It has been well known in the glass industry that salt-cake, especially when used in tank furnaces, is corrosive of the fireclay blocks with which the furnace is lined. In many instances the corrosion has been due especially to the existence of a floating layer of the salt-cake, and the most severe corrosion was therefore experienced on the flux line blocks, these requiring most frequent repair.

The observation which has been recorded in a previous paper[1] that in the neighborhood of 800° or 900° soda ash is much more corrosive than salt-cake, stimulated our interest to test experimentally whether or not at a higher temperature, especially when thoroughly mixed with the batch, salt-cake has the corrosive effect which has usually been attributed to it.

In a slight measure, the reply has already been given and recorded in a paper by A. Cousen and W. E. S. Turner[2] in connection with the production of colorless glass in tank furnaces. It was found in that connection that on the addition of even very small amounts of salt-cake a larger amount of selenium was needed, than when wholly soda ash batches were used to bring about decolorizing, and one of the reasons for this necessary increase was the higher proportion of iron oxide found in the glass when prepared from salt-cake-containing batches.

The results of these experiments may be summarized very simply in Table I. This table records the results of forty-two meltings in the same kind of crucible of the same kind of batch under definite conditions as stated in the table. The standard batch was 1,000 sand, 370 soda ash, 200 limespar, increasing amounts of the soda ash being replaced by their equivalent of salt-cake.

TABLE I.

IRON OXIDE IN GLASSES PREPARED FROM BATCHES CONTAINING INCREASING AMOUNTS OF SALT-CAKE.

A. Glasses Melted at 1,380°.

Parts of salt-cake per 1000 of sand.	No. of glasses prepared.	Range of Fe_2O_3 found.
0.0	6	0.06—0.08 per cent
13.5—54	3	0.04
13.5—54	9	0.06—0.09
13.5—54	16	0.10—0.15

B. Glasses Melted at 1,400°.

0	2	0.08—0.09
13.5—54	9	0.12—0.22

It will be seen that at the melting temperature of 1,380° there were three glasses containing a certain amount of salt-cake which contained a smaller amount of iron oxide even than those derived from the purely soda ash glasses. By far the greater number, however, of the salt-cake glasses contained a very distinctly larger amount of iron oxide than those produced from soda ash.

The data given in the paper referred to and quoted above leave no doubt that the presence of salt-cake in small amounts did bring about a slight increase in the iron oxide present, this impurity arising as the result of the greater corrosion of the pot.

It seemed to us desirable, however, that measurements should be extended to the case of batches containing quite considerable amounts of salt-cake and even to such as contained this material as the sole source of the alkaline oxide in glass.

*Jl. Soc. Glass Tech., Vol. VII, No. 27, Sept., 1923, Read at the Birmingham meeting, March 21, 1923.

[1]Donald Turner and W. E. S. Turner, *Soc. Glass Tech., Trans.*, 1923, 7, 207.

[2]*Soc. Glass Tech., Trans.*, 1922, 6, 168.

Accordingly, a series of glass batches was prepared in which the soda ash was gradually replaced by its equivalent of salt-cake, and from them glasses were melted. The batches themselves are stated in Table II.

TABLE II.

CORROSION OF FIRECLAY REFRACTORY MATERIAL BY SALT-CAKE GLASS. TABLE OF BATCH COMPOSITIONS.

	Sand.	Soda ash.	Limespar.	Salt-cake.	Coke.
A	1000	380	200	—	—
B	1000	375	200	6.7	—
C	1000	370	200	13.4	—
D	1000	360	200	26.8	1
E	1000	330	200	67.0	2
F	1000	280	200	134	5
G	1000	180	200	268	10
H	1000	80	200	402	16
J	1000	—	200	509	20

In order to avoid, if possible, floating salt-cake, a proportion of ground coke necessary to bring about reduction was added in each case except the two with least salt-cake, and it was found during the melting operations that when the pot was opened up for stirring, one hour after the second charge had been added, no salt-cake was visible and there was no sign that any segregation had occurred.

In carrying out the experiments, small crucibles were employed, each melting being made in triplicate, the three pots being set in the same furnace so as to ensure as far as possible similarity of furnace conditions. How successful we were in fulfilling this object will be recognized from the very closely agreeing analytical results tabulated in Table III. No lids were used on the crucibles.

TABLE III.

COMPOSITION OF THE GLASSES.

	SiO_2	Al_2O_3	Fe_2O_3	SO_3	CaO & MgO	Na_2O
A (Calcn.)	75.39	0.13	0.02		8.08	16.37
Expt. 1	76.20	0.25	0.11	0.03		
" 2	76.18	0.24	0.10	0.04		
" 3	75.80	0.28	0.10	0.01		
B (Calcn.)	75.39	0.13	0.02		8.08	16.38
Expt. 1	76.64	0.27	0.10	0.37		
" 2	75.46	0.26	0.10	0.37		
" 3	75.70	0.28	0.11	0.36		
C (Calcn.)	75.39	0.13	0.02		8.08	16.38
Expt. 1	75.69	0.28	0.12	0.29		
" 2	75.70	0.30	0.13	0.29		
" 3	76.06	0.33	0.13	0.24		
D (Calcn.)	75.37	0.13	0.02		8.08	16.30
Expt. 1	76.68	0.40	0.11	0.61		
" 2	75.56	0.46	0.12	0.54		
" 3	75.34	0.47	0.13	0.64		
E (Calcn.)	75.37	0.13	0.02		8.08	16.42
Expt. 1	75.08	0.59	0.11	0.79		
" 2	74.68	0.50	0.11	0.74		
" 3	75.28	0.68	0.14	0.65		
F (Calcn.)	75.34	0.13	0.02		8.08	16.44
Expt. 1	75.66	0.48	0.16	0.47		
" 2	75.70	0.48	0.14	0.45		
" 3	76.16	0.51	0.15	0.48		
G (Calcn.)	75.28	0.13	0.02		8.07	16.50
Expt. 1	75.78	0.90	0.16	0.45		
" 2	76.46	0.94	0.18	0.43		
" 3	76.24	1.02	0.16	0.38		
H (Calcn.)	75.23	0.13	0.02		8.06	16.57
Expt. 1	74.56	0.85	0.17	0.45		
" 2	75.52	0.92	0.16	0.40		
" 3	75.30	0.84	0.16	0.38		
J (Calcn.)	75.16	0.13	0.02		8.06	16.61
Expt. 1	74.94	1.13	0.17	0.38		
" 2	75.37	1 12	0.20	0.40		
" 3	76.06	1.20	0.22	0.41		

The pots were raised to a temperature of 1,250°, maintained at that value for two hours, raised to 1,350° in half an hour, and the first charge of batch then filled on as soon as the temperature of 1,350° had been attained. A second charge was added after half an hour interval. The glass was stirred after a further hour and a second time after the lapse of two and three-quarter hours from the addition of the second charge. After three hours the glass was poured.

The temperatures of 1,250° and 1,350° were selected as probably approximating to commercial conditions, as comparatively few manufacturers yet fire their tank furnaces or their pots for many hours at 1,350° or 1,400° before a charge is added.

Analysis of each sample of glass was then made in order to ensure first of all that corresponding glasses resulted and that the conditions for comparison therefore existed; and, secondly, in order to determine from the increase in the amount of alumina and iron oxide the extensiveness of corrosion. This method followed closely that already adopted in the preceding papers dealing with lead-containing glasses. It was not thought essential to determine the amount of lime or of the alkaline oxide present, the other figures being sufficient for the purpose of the experiment.

Table III sets out the results of our tests.

It may be noted that the amount of magnesia present varied from a trace to only 0.04 per cent, and consequently has not been recorded separately.

Generally speaking, there is good agreement between the results of the three determinations in each set with the same type of batch.

For the purpose of reviewing the extensiveness of corrosion a further table (Table IV) has been drawn up. In this table the amounts of alumina and iron oxide have been added, and the amount of these oxides present in the batch materials has been subtracted. The difference which is recorded, therefore, corresponds with the increase as the result of the corrosion of the pot. In order to simplify the table, an average has been taken of the three results in each set.

TABLE IV.

	Parts of salt-cake per 1000 of sand.	Average increase of Al_2O_3 and Fe_2O_3 in glass.	Average per cent. SO_3 in glass.
A	0.0	0.18	0.03
B	6.7	0.22	0.37
C	13.4	0.28	0.27
D	26.8	0.43	0.60
E	67.0	0.56	0.72
F	134.0	0.49	0.47
G	268.0	0.97	0.42
H	402.0	0.88	0.41
J	509.0	1.29	0.40

These results do not show a perfectly continuous increase in the amount of alumina and iron oxide, but the slight discrepancies may possibly be ascribed to a very slight temperature fluctuation, or possibly to slight differences in the condition of the different pots. Considering the results as a whole, however, the conclusion to be drawn is never in doubt. There is a definite and notable increase in the extensiveness of corrosion with the increase in the salt-cake present, the amount of the iron oxide and alumina taken during the fusion of the all-salt-cake batch being seven times greater than that from melting the all-soda ash.

It is of interest to note that observation of the pots themselves before any analysis was made was quite in agreement with the subsequent results of analysis. The part of the pot most affected was the line of contact between the glass and the pot itself. At this level the ring, or rather band, which was observed became deeper as the amount of salt-cake was increased.

It seemed to be of interest to test whether or not the amount of corrosion had any connection with the proportion of sulphate or salt-cake left undecomposed in the glass, and although the glasses were not completely analyzed this special constituent, namely, SO_3, was determined.

It will be seen from the table that there appears to be no connection between the SO_3 content of the final glass and the extensiveness of corrosion. The latter depends almost certainly on the action of the batch during its course of melting and not on the resulting glass. It would be of interest to ascertain to what extent the degree of corrosion varies with the temperature of the furnace, and when the opportunity permits we propose to carry out this test.

DISCUSSION

MR. E. A. COAD-PRYOR said he assumed there was no intention on the part of the authors to claim that any one of the clays tested was better for the pot-maker than another; for there were obviously a number of other factors bearing on this point.

It would be rather interesting to know whether, in these particular experiments, the porosity was roughly proportional to the attack. From one of the figures shown on the slide he gathered that it was not. He was very much interested in the test of spraying the pot with soda ash. It was specially interesting because there was reason to suppose, as Prof. Turner had hinted, that the reverse, in certain circumstances, would be expected to happen. There did not appear to be any doubt that when refractories were in contact with glass something happened which made the refractory a good deal more insoluble in the glass. Possibly, in the spraying test, a little too much soda ash had been sprayed on. Or possibly by the volatilization of the silica there might have been a stiffening up of the refractory. One noticed this particularly in tank furnaces, where the refractory material never got anything like so hot as in the experiments which had been described. He had brought with him two samples of tank blocks which had recently been taken from a tank furnace. One was of a texture to produce this stiffening, and the other of a very similar composition, but of a different texture, which did not show such vitrification in use. This difference was rather interesting, because, in the case of a tank block, the furnace was cooled from the outside, and therefore never really got very hot. This block had worn like stone, whilst the other had worn away quickly. In the light of these observations, it struck him as rather curious that the spraying test had failed to cause improvement.

It was also mentioned in the paper that there was practically no corrosion of the pot after the batch had once melted down.

It would be interesting to know whether the authors had ever tried, or contemplated trying, another melt in the same pot, or glazing the pot before the experiments were started. Incidentally, he would also like to know if there was any grog in the pots.

The last result of the salt-cake series of experiments was both interesting and surprising. One would have expected, of course, from the observation of melting conditions, that the small amount of salt-cake would have had a beneficial effect, but one would like to know whether the experimenters noticed in the pots any corrosion along the flux line, which would be more indicative of salt-cake being on the top than any observations described.

MR. W. F. PEARSON asked if the authors could say what would be the effect on the corrosion of blocks having a larger percentage of sodium chloride in the salt-cake.

DR. R. D. BAIN: In the first paper attention had been directed to the rather large corrosive effect of the materials from the batch at the low temperature of 800°, and amongst one of the sets of figures the relative corroding effects of sodium nitrate was mentioned as 42, and potash 61, whilst at the same temperature salt-cake had practically no corrosive action. He rather imagined that in tank furnaces when feeding on a batch, the latter must pass through the temperature of 800° in order to get up to the melting point of 1,300° or so. Secondly, for a rather long period, the batch remained at 800° or thereabouts. The corrosive action of the other materials then was considerably greater than that of salt-cake.

It would almost appear that the corrosive action of the other ingredients of the batch was greater over the whole range than the total corrosive action of salt-cake in the later stages.

MR. E. A. COAD-PRYOR asked if it was possible that the viscosity of the glass might have some effect on the problem of corrosion.

MR. G. V. EVERS: "In connection with the corrosive action of salt-cake, nothing had been said as to the composition of the block. Was that available?"

PROF. TURNER: "Yes."

MR. G. V. EVERS said that he would like to ask the authors what difference they would expect in the behavior of the blocks if there had been a considerable addition of silica to the clay in preparing the block.

COL. S. C. HALSE asked if Prof. Turner could add some remarks to the paper when published on the action of glass on refractories as contrasted with the batch materials themselves. He had recently had to do with a tank in which extensive corrosion of the side blocks had occurred to a very considerable depth, whilst very great action on the bottom of the tank was also perfectly obvious when the tank was emptied.

DR. CRONSHAW: The papers had been very interesting from the chemical point of view, but he thought they would be of additional interest if Prof. Turner could give some further information as to the physical properties of the refractory materials tested—the porosities of the materials, their permeability, the particular methods of working the pots, and the physical state of the glass. The knowledge of the viscosity of the glass at various stages during the experiments would also be useful in this connection.

PROF. W. E. S. TURNER, in reply, said he would endeavor to take the questions, as far as possible, in order.

Replying to Mr. Coad-Pryor's question concerning the porosities, the corrosive action was not proportional to the porosity of the clay. There appeared to be three or four factors in operation, and none of these factors seemed to be dominant. A description of the clays would be embodied in the text of the paper, but it might be said that the clays tested were those the physical properties of which had been investigated at Sheffield and the results already published of the shrinkage, porosity and so on, up to quite high temperatures. With regard to the action of soda ash sprayed on the pot, there was no doubt of the negative value of the treatment in these particular experiments. In several cases, however, particularly in the preparation of boric oxide glasses, during which extensive corrosion occurred, they had tried various methods of reducing it, and spraying with soda ash had appeared of advantage in one or two cases. Therefore, they were in some way surprised at the negative result in this particular case. Additional tests might be usefully carried out.

The samples which Mr. Coad-Pryor had exhibited were certainly interesting from the point of view of the difference in density, despite the low temperature to which they had been subjected.

With regard to Mr. Coad-Pryor's suggestion to test the corrosion after the pot had already been used once and was therefore well glazed, or to glaze a pot first before melting, this should in due course be done.

In reference to the question of the amount of grog in the pots, full details would appear in the paper. Some of the pots were specially prepared without grog; others contained 25 per cent.

The test of repeating a melting in the same pot, as suggested by Mr. Coad-Pryor, might certainly be tried with advantage; but he thought the test which had been done was fairly conclusive, namely, the test over the twenty-four-hour period, during which there was practically no increase of attack as compared with the three-and-a-half-hour period.

With regard to the question as to whether there was any corrosion at the flux line when salt-cake was used, he would say, yes, quite definitely. In fact, although they went to the extent of carrying out these analyses, they could have stated the order of corrosion by an examination of the pot. He would not say that a ring was formed at the surface, but there was at any rate a very broad band of depression, the depth of which increased as the amount of salt-cake increased. He would not, however, agree that this effect was due to floating salt-cake. In the very early stages, of course, they could not be absolutely certain that none came to the surface. The pots were, however, closely watched, and the observer at no stage had any evidence of salt-cake coming to the surface. He thought there might be causes for this flux-line attack other than those associated with floating salt-cake. He considered Mr. Coad-Pryor himself in work on corrosion had pointed to one cause, namely, the presence of convection currents. Another possibility was something similar to what he (Prof. Turner) had himself noticed during autoclave tests on chemical glassware. Several times extensive corrosion at the wind and water level was observed, and in one case the ring passed round not only the inside of a flask, but there was a corresponding ring on the outside of the flask corresponding with the water level inside—an extraordinary phenomenon, the reason of which he was not quite clear about. He would not, therefore, be inclined to think that the extensive corrosion of the salt-cake batch at the flux line was necessarily due to floating salt-cake.

With regard to Mr. Pearson's question on the effect of sodium chloride in salt-cake on fireclay blocks, fortunately one did not often meet with this to any great extent nowadays. He had no doubt at all that, like the effect of salt-cake on the surface, so also sodium chloride was corrosive. It certainly had been shown by Cobb that sodium chloride did act on fireclay, forming a definite silicate, containing sodium oxide, alumina and silica. The action was slow at low temperatures, but probably at glass furnace temperatures it was extensive, especially in the presence of moisture.

Dr. Bain suggested that as the batch had all necessarily to pass through a temperature of 800°, at which point soda ash was more reactive than salt-cake, possibly the total corrosion was more due to soda ash than to salt-cake. He (Prof. Turner) thought that the results were perfectly clear in showing that when a soda ash batch and one containing salt-cake but otherwise of precisely corresponding composition were melted under precisely the same conditions, the soda ash batch was always much less corrosive. In each experiment the total corrosion was determined.

In the case of charging into a tank furnace a good deal of the batch did not come into contact with the blocks, although some of it did.

With regard to the viscosity of the respective glasses, a point raised by Dr. Cronshaw, their experience had always been that that of the sulphate-containing glass was higher than the viscosity of the soda ash glass, and for that reason one would rather expect the attack to be somewhat less, rather than greater. General results, which were known, indicated in many cases—although this was by no means certain—that the greater the mobility of the glass the greater was the attack. Certainly extensive corrosion was met with in the case of lithium glasses, in which the viscosity was much less than in soda or potash glasses.

Mr. Evers had asked about the compositions of the clays. These were all available and they would appear in the text of the paper. They were not able to draw the conclusion that an aluminous clay was better than a siliceous clay. One of the aluminous clays was least corroded, but in another case, where the corrosion was extensive, that clay was also aluminous. It was quite likely that the relative order of resistance varied with the temperature of previous firing.

As to the effect of silica, so far as general solubility was concerned, he would be rather inclined to speak with some diffidence on the point as to whether, if the silica were better distributed through the mass of the clay, the corrosion (or solubility) would be less than if the silica were present in larger portions. The portions exposed might dissolve out, whereas if the silica were distributed uniformly one would expect the solubility to be more uniform and regular. He would like to hear opinions based on experience.

With regard to the effect of the flow of glass on corrosion, especially round top blocks, this had been well known by many glass manufacturers during the past three or four years. The flow of the glass, as well as the chemical cor-

rosion, was an active factor in the destruction of tank-blocks, especially if they showed any tendency to be of a spongy character; that is, if the porosity was rather high. The top course was naturally the seat of a more active chemical action in the melting of the batch, and he thought it should occasion no surprise that the top blocks should wear thin. What had been rather astonishing was the fact that at one or two factories it had not been the top course of blocks, but the second course, which had suffered the more extensively.

Turning to the remainder of Col. Halse's question, he thought 3 ft. 9 in. was reasonably deep even for a pale metal tank. The temperature at 3 ft. 9 in. deep should not, he imagined, be excessive, and certainly the amount of glass taken out—50 tons per week—was not particularly great. It was therefore astonishing to find the bottom going so rapidly. He would hesitate to express any opinion other than the fact that there was possibly a distinct current of glass along the bottom of the tank; or that the porosity of the binder blocks put in was rather high.

It was rather interesting to hear that at the working end, where the temperature would probably be some hundreds of degrees less, the binders were intact.

Any further questions on the subject which might be sent in, or any to which he had omitted to reply, he would be pleased to attempt to answer, if members would submit them in writing. He would also be glad if any glass manufacturers or technical workers would care to amplify any of the points with which he had endeavored to deal, as he felt that on several matters further information might be obtainable from day to day factory observations.

The Fuel Supply of the German Glass Industry

By Hubert Hermanns

The manufacture of glass takes pride of place among the German industries, not only on account of its magnitude but because it is in a class by itself, all the raw material and the fuel required for making glass being extant in large quantities in the country itself or produced there. In contrast to this most other German industries on a large scale are compelled to obtain part or all of their raw materials from abroad. It is for this reason that, even before the war, the German glass industry supplied a large part of the world's markets with glassware and *de luxe* glass, for which there was a ready sale. Owing to the influence of the war very considerable and far-reaching changes have taken place. After German glassware could not be obtained during the war many countries started glass works of their own. An appreciable part of the new works continued operations after the conclusion of the peace treaty, although it was soon found that operating and market conditions did not allow of successful competition with the German glass works and those of other countries. The result was that a large number of the new works finally ceased operations.

Russia used to be one of the principal customers for German glassware before the war, but today under the sway of bolshevism the country is incapable of absorbing much of such products, and on this account the market for German glassware has been severely curtailed.

In addition there are other difficulties from which the whole German industry has to suffer and which are both political and social, so that with the general scarcity of fuel the German glass industry has to face a very serious situation. The first problem to be solved was to allay the internal difficulties in the various plants. The German glassworkers have been much affected by the political and social changes that came about after the war. Numerous skilled workers have been killed at the front or have become invalids incapable of the heavy work. Besides this, and as the glass industry was not indispensable during the war, many glass works had to shut down owing to lack of orders or workers or because of scarcity of fuel. In consequence many skilled glassworkers were compelled to enter other indispensable industries and, for the major part, were lost to the glass industry forever. From the foregoing will be clear that the quality of the glassworkers had much deteriorated at the end of the war. It stands to reason that this fact had to react on the quality of the product, and during the first few months after the end of the war there was some ground for complaints. It took a long time to train the workers afresh and to accustom them again to the production of high quality goods.

The task was not an easy one because the glassworkers have been much radicalized through the political and economic change. However, the German glass industry has succeeded in surmounting all difficulties in this respect.

Another problem, not less serious, was the supply of fuel required by the industry. In order to enable all industries to continue operations coal was apportioned to such industries only that cannot obtain the temperatures required by using lignite. Now, some glass works that were situated near lignite deposits had learned even before the war to produce temperatures high enough to melt glass by using brown coal. On the strength of this old experience the glass industry generally was referred to the use of lignite, coal being withheld. This measure was of most draconic character because by far the largest part of the German glass works had no experience whatever with the use of lignite stoked furnaces, so that at first they did not know what to do with this low grade fuel. In spite of all this the official regulations—apart from relief granted in some individual cases—have on the whole been carried through.

The very incisive effect of these measures can be seen from the following figures: In all the German glass industry comprises 350 works with 1,500 melting furnaces. Seventy-five of these works are located in northern Germany, 105 of them in South Germany, 60 in the province of Silesia, and the balance is split up among western and central Germany. In the main the Silesian and central German as well as a few Rhenish glass works only are located in the neighborhood of lignite deposits while all other works, and among them the largest and most important ones, owing to their

geographical position used to operate on coal and were now compelled to adapt themselves to employing lignite for fuel. There is this further point to consider that only a few of those works that had been using lignite before had used it in the crude state. The majority of them were stoking on lignite briquettes. As briquetted lignite shows a calorific value of about 2½ times that of crude lignite it is easy to realize the engineering difficulties which had to be overcome in using this low grade fuel instead of the former high grade one.

The total demand of fuel of the German glass industry in 1921 amounted to 2,000,000 tons of coal. In case this demand would have to be met by crude lignite the fuel quantity would be three times as large. If, for argument's sake, we take a medium size glass works with a coal consumption of 20 tons per day, three times this amount, i. e., 60 tons per day, would have to be discharged, transported and stoked. It is obvious that neither the furnace arrangements nor the other mechanical auxiliaries would be capable of successfully dealing with this quantity. Under the present economic conditions, more especially as regards labor charges, it is possible in Germany to discharge and transport 20 tons by hand in an economic manner. However, this is impossible in the case of 60 tons because the transport charges per thermal unit rise to three times the original figure. To bring them back to a reasonable figure suitable mechanical transporting devices have to be procured. It was impossible to do that at once because the erection of such devices required some considerable time.

FIG. 1.

The discharging device shown in Fig. 1 has been erected in a number of glass works. As its working expenses are low the cost of discharging as little as 30 tons per day is less than in the case of manual work.

Every fuel and furnace expert is aware of the fact that a furnace with a capacity of 20 tons of high grade coal per day is incapable of dealing with 60 tons per day even if the latter fuel in all develops the same amount of thermal units as the 20 tons. Natural gas or other high grade and suitable fuel not being available the German glass industry is using nothing but producer gas for heating the furnaces. Naturally, the gas producers are arranged for a certain charge of fuel, and if in a gas producer which is capable of gasifying 10 tons of coal within 24 hours an equal amount of crude lignite is gasified about the same volume of gas will be obtained. However, this gas will be composed to one-third only of combustible constituents, the rest being nitrogen and water vapor. It is obvious that gas of this description is unsuitable for obtaining temperatures exceeding 2,900 deg. F. For producing the same number of thermal units as with coal at least three times the quantity of lignite has to be gasified. The result is that the volume of gas obtained is three times as large also, and has to be appreciably reduced in order to secure a higher grade gas. As it is particularly the water vapor content that detrimentally affects the calorific value, the water vapor has to be removed from the gas.

In principle it is not difficult to separate water vapor from producer gas. The temperature of the latter need only be sufficiently lowered when the water vapor will condense to water and form a deposit of water drops. In actual practice the dew temperature of water vapor is found to be 160 deg. F. Hence all that is required is to make the producer gas flow through passages or pipe lines until it has attained this low temperature. However, on the other hand, this reduction of temperature of the gas is connected with a very important technical disadvantage in as much as the dew point of the water vapor practically coincides with the dew point of the tar vapor. As a result the tar vapor contained in the gas condenses together with the water vapor and in lowering the temperature of the producer gas the latter loses a considerable part of its calorific value. This loss is accentuated by the lowered temperature of the gas itself and by the loss of sensible heat thus brought about. From what has been said it will be seen how far-reaching engineering and economical problems are connected with the generation of producer gas from lignite: Larger numbers of gas producers; alteration of gas producers to make them suitable for the gasification of fuel with high water contents; enlarging cross-sectional area and distance passed in pipe lines; enlarging gas burners of the furnaces to make them suitable for dealing with larger gas volumes; arrangement of water pockets in the gas lines for collecting water and tar.

Probably these difficulties would not have been overcome except for the Verband der deutschen Glashütten (Association of the German Glass Works) who by originating a consulting office for heating problems has taken up these questions and organized their solution. This heating problem office is under the management of an experienced chief engineer who, assisted by a staff of heat experts, has to carry out experiments in the various glass works in order to ascertain the heat efficiency of the furnaces and to use these results for making suggestions as to the reconstruction of the furnaces and their adaptation to stoking with low grade fuel. Several large glass works have taken the solution of these problems into their own hands and by arranging for heating problem offices of their own they utilize the experience gained by practical and scientific workers. Anyway, the German experience has been proof positive that there is no better method for saving fuel and for using low grade fuel economically and successfully than by continuous scientific and accurate tests and by carefully watching all combustion processes in the furnaces.

Lime in Glass Making*

By R. R. Shively†

All three forms of lime, burned, hydrated and raw, are used in glass. Each form has its advantages and likewise its advocates, and it is the idea of this article to discuss in a general way the merits and objections to each.

Before entering upon the main discussion it seems advisable to give briefly the function of lime in glass. Lime is the cheapest flux available and in the soda lime glasses, that is, window glass, bottles, jars, etc., it has the property of reducing the solubility of the glass. The solubility decreases as the lime increases, or in other words the glass becomes more durable as the lime increases. The percentage of lime in bottles and jars is from 6 to 12 per cent, in window glass from 12 to 16 per cent. Glasses have been made containing as high as 25 per cent lime, but these devitrify badly and are not considered good glasses.

In the writer's opinion, glass should contain, where durability is desired, not less than 8 per cent lime and it is advantageous to have between 1 and 2 per cent of alumina present, which aids in reducing solubility and helps in preventing devitrification.

It might be well to note here that high calcium and dolomitic limes are both used in glass, and that each has its advocates. However, the merit of these limes will not be taken up here, as this subject would furnish material for a paper within itself.

Raw lime is used almost exclusively in window glass and some is used in making flint glass for bottles and jars. Its advantages are that it is the cheapest form of lime, it is less objectionable to the workmen in handling and it is constant in composition. Its chief disadvantages are that it contains organic matter which is objectionable for flint glass, unless some salt cake, niter or other oxygen carrying material is added to the batch to eliminate the carbon. It is also the writer's opinion that the rock is not as carefully selected as that which is burned and that there is greater difficulty in obtaining raw limestone low in objectionable material than in securing satisfactory burned lime.

Theoretically, a limestone batch requires more heat to flux than one made of burned lime. However, when it is considered that not over 10 per cent of the heat introduced in a glass furnace is really utilized in melting the glass, this is not as important as it seems. In fact, certain investigators claim to have found that a limestone batch melts better than burned lime and attribute it to the escaping carbon dioxide from the limestone, which they claim gives more agitation and speeds up the fining of the glass.

Burned lime is used in most instances where good color is desired. This is true because it is possible to secure burned lime containing less than 1/10th per cent iron and free from organic matter. In the past year a great stride forward has been made by the producers of burned lime. Certain manufacturers are now determining the loss on ignition on each car as shipped and sending these results to the consignee. This work has been handled by the National Lime Association and has been of great help to the glass manufacturers. Burned lime with an ignition loss of less than 3 per cent is now easily obtainable.

The chief objections to burned lime are its unconstant composition, its increased cost and its being unpleasant to handle. But the writer prefers it, and his experience is that more glass can be melted where it is used than when either of the other forms are used.

Hydrated lime is used very little in glass manufacture. Its chief advantage is constancy of composition, and it is the purest form of lime, but its greatly increased cost makes it undesirable.

The Bureau of Standards has published specifications for various forms of lime for glass making, but on account of the varied glasses and the different size of furnaces it is difficult to give complete specifications. The important thing is uniformity and when a manufacturer gets accustomed to a lime there should be no great variation in subsequent shipments. The following general specifications are proving satisfactory:

Grinding: Limestone is used in sizes from 100-mesh up to pea size, depending upon the conditions under which it is used. In the larger furnaces coarse stone is usually employed.

Burned Lime: Should all pass a 20-mesh screen.

Hydrated Lime: Is always fine enough.

Alkaline Earths: Limestone should contain not less than 93 per cent calcium and magnesium carbonates. In burned lime the calcium and magnesium oxide should not be less than 90 per cent.

Iron: In general, the iron content should not be over 0.1 per cent Fe_2O_3 based on limestone.

Sulphates: Some object to the presence of sulphates, but the writer does not. There should be no great variation in different shipments.

Silica and Alumina: These substances are not objectionable, but there should be no considerable variation in different lots.

Frequently glass manufacturers lay their troubles to glass making materials, and as sand and soda ash are both supplied in extremely pure forms, lime receives more blame than anything else. Experience leads the writer to believe, however, that the larger part of the troubles are due to furnace conditions, usually lack of heat.

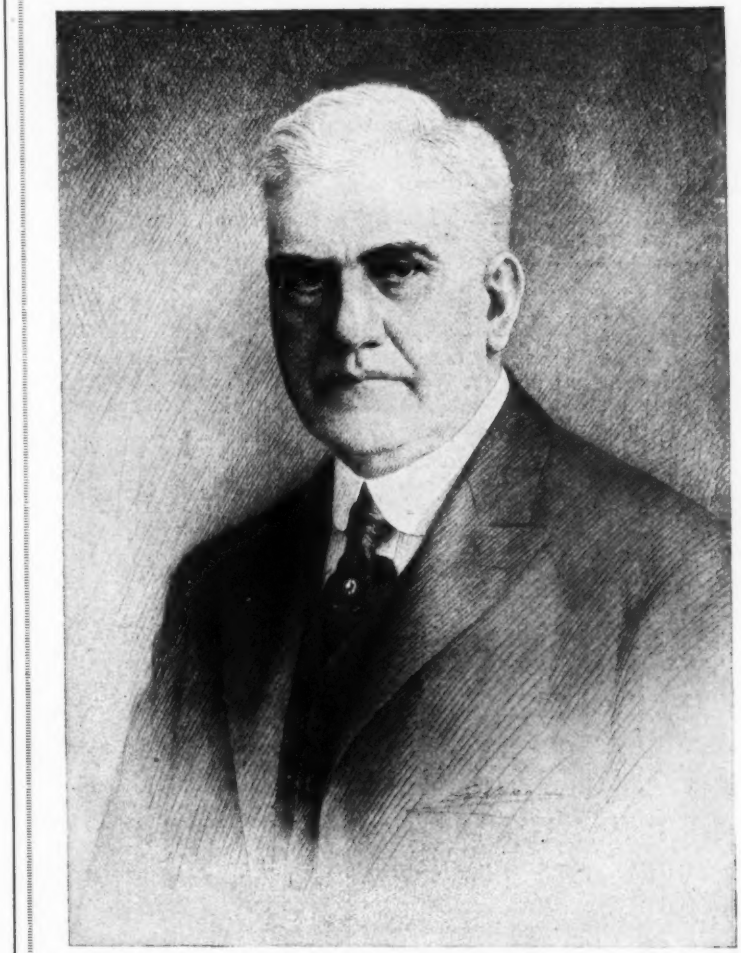
In closing it seems fitting to say that, to the writer's knowledge, the National Lime Association has been tireless in its efforts to assist glass manufacturers.

*Rock Products, Sept. 8, 1923.

†Chief Technologist, B. F. Drakenfeld & Co., New York.

Calculating Heat Values

A number of empirical formulas have been proposed from time to time for use in calculating the heat value of a fuel from its ultimate analysis. For solid and liquid fuels this method can never give very accurate results. For gases, however, it is quite possible to determine the heat values from their analyses, as the heat value of each of the entering constituents has been determined with great accuracy.—*G. W. Akerlow*



MICHAEL J. OWENS

Born January 1, 1859, Died December 27, 1923

THE sudden and much deplored death of Michael J. Owens, inventor of the Owens automatic bottle machine and vice-president of both the Owens Bottle Company and The Libbey-Owens Sheet Glass Company, which occured in his office at Toledo, Ohio, on December 27, brought to a close one of the most remarkable industrial careers in the history of the country. From a very humble beginning Mr. Owens progressed with his wonderful mechanical creations, to a position of conspicuous leadership in the glass industry.

Bottle-making methods which had been used throughout the world for two thousand years without appreciable improvement were quickly revolutionized by his inventions. The enormous saving of hand labor which his machines effected made him a public benefactor. In comparison with the achievement of making two blades of grass grow where but one grew before, he made thousands: his largest machine, the fifteen-arm type, has produced more than ninety small bottles or fifty pint bottles per minute.

"His name will be associated with bottle manufacture as long as civilization remembers its benefactors."

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CONTENTS

	Page
The Production of High Grade Colorless Glass in Tank Furnaces	1
The Effect of Salt Cake in Soda-Lime Batches in Corroding Fireclay Refractory Materials	2
The Fuel Supply of the German Glass Industry	6
Lime in Glass Making	8
Death of Michael J. Owens	9
Editorial:	
Looking Forward	10
History of the Spectacle Trade	11
High Prices for Old Glass	11
Recent Patents	12
Natural Gas in 1922	14
The Glass World and What It Is Doing:	
Libbey-Owens' Sixth Annual Report	15
A Remarkable Catalog	16
Window Glass Agreement Held Valid	16
Damages Suffered by Tokio Glass Factories	17
Morgan Gas Producers in Glass Field	17
Two-Year Wage Agreement Assured	17
Glass Division at Atlantic City Convention	17
Pittsburgh Glass and Pottery Exhibition	17
Coming Meetings	18
Verified News of Trade Activities	18
Personal Items	19
Recent Deaths	19
Inquiries Received	19
Stock Quotations	19
Current Prices of Glass-Making Materials	20
Monthly Summary of U. S. Foreign Commerce in Glass	20

CLASSIFIED BUYERS' GUIDE, PAGE 16

Readers of THE GLASS INDUSTRY in the United States and elsewhere are requested to favor the Editor with any information available from time to time concerning developments in their own or other fields which would be of general interest to the industry. Authoritative facts about new glass manufacturing projects, re-organizations, new factory construction, new processes and equipment, raw materials, manufacturing and market conditions, personal items, and other appropriate subjects would be welcomed.

Those experienced in the practical, technical or executive activities of glass manufacturing who are qualified and willing to lend their aid to the upbuilding and progress of the industry by giving from their store of knowledge to others, are invited to submit for publication articles on any subjects relating to glass which would be of interest and value to our readers. The authors of accepted articles of this kind will be compensated at usual rates.

Looking Forward

At the end of the year, when the old exhausted calendar is discarded and a thick new one, suggestive of many business days to come each with its tremendous possibilities for weal or woe to the glass industry, takes its place on our wall or desk, it is both natural and logical that we should pause and look back over the twelve months just ended, noting the course followed and what it has led us to; then face forward and endeavor by the foresight acquired through past experience to penetrate the mists of the future and discern the direction of the road we shall take during the new year.

As for us, we believe that for the great industry of glass manufacturing the road will continue to be a prosperous one. Inquiries among representative glass men elicited similar opinions. For instance, W. L. Clause, chairman of the board of directors of the Pittsburgh Plate Glass Company, one of the greatest of glass manufacturing concerns, tells THE GLASS INDUSTRY that

> "The fundamental conditions underlying business are better than they were a year ago, and I think business should certainly be very good for the first half of 1924, and probably for the entire year.
>
> "Every branch of the plate and window glass industries is in the process of active evolution. Ten years will probably see greater changes than have ever been wrought in these industries in a like period of time. The prospect of tax reduction and the defeat of the soldiers' bonus has heartened every business activity, and President Coolidge's program, if executed, will have a very stimulating effect upon the growth of the country and the full employment of its workers.
>
> "We do not believe in the abandonment of restriction of immigration, but there should be some relaxation that would mitigate existing evils and insure a reasonably adequate labor supply."

J. D. Robinson, of Toledo, Ohio, president of the Libbey Glass Manufacturing Company, discussing some of the national questions of the day as well as problems of the glass manufacturer, said that he is in favor of

> "Government tax reduction to provide for economical administration of government obligations only, and to prevent forcing of wealth into tax exempt securities—but rather keeping it in business channels.
>
> "I am opposed to soldiers' bonus. I do not believe patriotism in service should be rewarded, except in case of actual need.
>
> "I believe in restricted immigration, and that emigrants should be of selected type at point of departure—through our own government supervision.
>
> "Foreign competition is a complex question of future problems,—we should meet it by protective tariff to equal the difference in cost of labor to maintain our standards in the United States.
>
> "Fuel as a commodity should be left to work out its own right of production and sale, except when emergency conditions arise, then the public's rights through government supervision should step in and decide.
>
> "The past ten years have brought the greatest development in the mechanical field to the glass industry of all times back, and I believe the future ten years bids fair to equal the past. I hope the artistic in glass manufacturing may also come back into its own during the same time."

H. C. Fry, president of the H. C. Fry Glass Company, Rochester, Pa., gives his views as follows on the prevailing situation and the needs of the industry:

> "During the past three years the glass business has

been depressed and general sales under normal, with union labor oppressive. The outlook for 1924 is much brighter in prospect for increased business and firmer prices. The tax reduction plan advocated by Mr. Mellon, Secretary of the Treasury, will be a wonderful factor toward general prosperity. I am opposed to soldier bonus for able-bodied men. Immigration should be increased. Foreign competition is severe and our tariff should be more carefully enforced. Technical development is making fine headway. New researches show continued betterment. What industry needs is confidence and the honest co-operation of all. Our laws should be rigidly enforced and our President's firm policy endorsed."

J. W. Cruikshank, of the J. W. Cruikshank Engineering Company, Pittsburgh, Pa., whose activities bring him into close contact with many producers of glass, believes a prosperous year is in sight for the whole country. He says:

"The elements for the coming year would seem to guarantee increased material prosperity for this country. There was much doubt as to our new President before he read his address to Congress but now the consensus of opinion tends to show that while he is conservative he has initiative, and will inaugurate a constructive program. If anyone doubts the ability, firmness and integrity of our President they should refer to his record.

"I believe we are indeed fortunate in having such a statesman at the head of affairs. This factor should minimize the uncertainty of a presidential year, for the endorsement of Coolidge for a second term by the best interests seems assured. The glass trade has had an era of great prosperity which has been shared by all branches of this industry. The present outlook is good and the country is developing many new lines in all industries, which leads to increased business in this."

These quotations go to show how the glass manufacturers feel about the future. They are looking forward with confidence to the year just entered upon. They are men actively engaged and in daily contact with the various phases of the glass making business. Who should know better than they what the trend of the industry is going to be throughout the year 1924?

We wish our readers A Happy and Prosperous New Year, and believe they are going to get it.

Death of Michael J. Owens

The announcement on December 27 of the sudden death that day of Michael J. Owens, the famous inventor of the automatic bottle machine bearing his name, and officer and director of several large glass companies, brought a shock to the industry that will be felt long and deeply. Few if any individuals in the glass business are so widely known by reputation as was Mr. Owens, and his personal friendships and acquaintances were very numerous, extending to all parts of the world. Word of his death was received with regret throughout the country.

It is seldom that a single individual exerts such a far-reaching influence on an industry as did Mr. Owens on bottle manufacturing. An authoritative account of his achievements in the automatic bottle machine field may be found in "American Bottles, Old and New," by William S. Walbridge, vice-president, The Owens Bottle Company, and published by that company in 1920.

History of the Spectacle Trade

At a meeting of the Optical Society held at the Imperial College of Science and Technology, South Kensington, London, on November 27, 1923, Dr. M. von Rohr., of Jena, delivered the 1923 Thomas Young Oration. The date was the 123rd anniversary of the delivery by Thomas Young of his famous Bakerian Lecture "On the Mechanism of the Eye." The subject of the Oration was "Contributions to the history of the spectacle trade from the earliest times to Thomas Young's appearance." For the following review of Dr. von Rohr's address we are indebted to F. F. Bryson, Honorable Secretary (Papers) of the Society.

The lecturer divided the subject chronologically into six parts and detailed the work done by different nations. The first period beginning in the 13th century extends to the invention of printing, about 1448. Comparatively few spectacles were then in use and our knowledge of their production, distribution and price is very limited. The second period relating principally to the growth of the South German spectacle factories from about 1450 up to 1620 is much better known. Thanks mainly to an oculist (Dr. V. Pflugk of Dresden) our knowledge of the statutes and trade customs is quite remarkable, and exact details as regards the outward appearance of the spectacles then in use, their construction, distribution, and prices are available. At about the same time Venice must have been another important centre of spectacle manufacture, but unfortunately our knowledge of the glasses produced there is deplorably deficient. We are aware that in the early days of the telescope (the Dutch form and the terrestrial telescope, both made of single, unchromatised lenses) Venetian craftsmen were supplying these instruments; but of Venetian spectacles proper only some casual hints are ascertainable. In both these centres, however, 'near" spectacles (for reading and working) only were made. Notable developments took place in Spain from about 1560 up to 1710; distance-spectacles fastened to the head were worn everywhere, even in the highest circles of Spanish aristocracy. This we know not only from certain French histories that are not free from satire and irony, but also from such incontestable relics as pictures, engravings, medals. There we find high Spanish dignitaries, including a Viceroy of Naples, represented with nose-spectacles. At this time also Spanish spectacles which were held in position by threads over the ears were introduced to China and Japan by Spanish Jesuits. Another chapter, devoted to the decline of the South German spectacle factories between 1620 and 1780 shows the development of the cheapest nose spectacles. The chief development in this direction occurred in Nürnberg, between about 1640 and 1740 in a clever and effective manner; it is only a pity that the makers' principal object was to turn out the greatest quantity of extremely cheap (and sufficiently nasty) goods. The last part of the lecture described the growth of the spectacle grinding optician, and related principally to the London opticians of the 18th century. The patent specifications have preserved exact data with regard to the aims and methods of these old craftsmen. The greater accuracy indispensable with achromatic objectives (invented by Chester Moor Hall in 1733 and put on the market by John Dolland after 1758) placed the London spectacle maker proper on a much better footing than his Nürnberg competitor working with bad tools and to a very small degree of accuracy.

High Prices for Old Glass

Early American glass collected by Jacob Paxson Temple brought high prices at a recent sale at the American Art Galleries, New York. Specimens of Stiegel workmanship, 1763 to 1774 predominating. A rare Stiegel urn-shaped, covered clear glass bowl, purchased by W. W. Seaman, agent, for $470, brought the highest price.

High prices were obtained for other Stiegel pieces as follows: An emerald green glass sugar bowl, to A. Rudert, agent, for $310; a sapphire blue glas creamer to W. E. Adams, for $130; a large light green glass pitcher to Miss A. B. Jones, for $105; an etched clear glass covered flip to W. E. Adams, for $135, and an amethyst, trumpet shaped glass vase to H. Bacon, for $200.

A pear shaped amethyst glass perfume bottle went to W. W. Seaman, agent, for $320; also a second bottle similar to the preceding, for $280; a sapphire blue glass sugar bowl, to T. P. Bissell, for $190; an amethyst glass bowl to the same buyer, for $100; a deep covered bowl, and an amethyst glass covered sugar bowl to Alfred Roe, for $140 and $110, respectively. Miss A. B. Jones paid $140 for a Millville ruby glass vase and E. B. Aldrich $110 for a Milville amber and green glass pitcher.

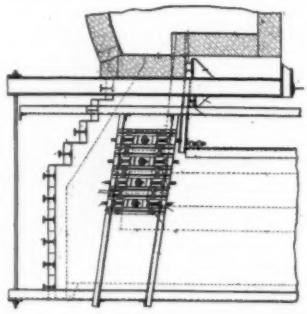
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

Burner for Furnaces. U. S. 1,475,194. Nov. 27, 1923. William A. Morton, of Pittsburgh, Pa.

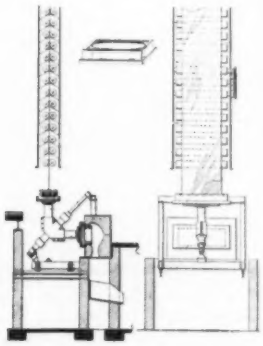
This invention relates to a burner designed for use in connection with large commercial furnaces, particularly glass furnaces and open hearth furnaces.



Among the inventor's claims is a burner for furnaces having a side wall in which is a horizontal substantially rectangular burner port, said burner including a horizontally extending bottom member having its inner end terminating at the said burner port, a top spaced above the bottom and having its inner face inclined downwardly toward said port where it terminates, a substantially flat horizontally extending partition spaced between the bottom and top and terminating at some distance back of the port, said partition being in the form of a flat arch made up of a series of contiguous sections comprising a row of refractory blocks, means for adjustably holding the blocks in each row under pressure in a lateral direction, means for effecting a vertical adjustment of each section independently of the others, and vertical sides, said sides, bottom, top, and partition providing a transversely rectangular upper passage above the partition, a similar lower passage below the partition, and a transversely rectangular passage between the end of the horizontally extending partition and the port with which the upper and lower passages communicate, means for conducting fuel to one of the passages formed by the horizontally extending partition, and means for conducting air to the other.

Art of Drawing Glass. U. S. 1,475,527. Nov. 27, 1923. Hugo J. Walter, of Bradford, Pa., assignor to Interstate Window Glass Company, of Bradford, Pa.

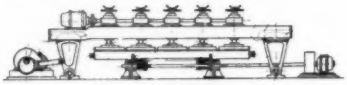
This improvement in the art of drawing glass sheets consists in drawing sections successively from a series of charges, welding each section to the preceding section during the drawing operation, and annealing the drawn sections simultaneously with the drawing of succeeding sections.

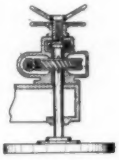


After all the glass has been drawn from the pot, except such small residue as experience or circumstances may determine to be necessary or advisable, the drawing operation is stopped and the drawn sheet is cut, burnt or otherwise severed as close as possible to the pot. The apparatus is then raised as an entirety until the lower end of the sheet is clear of the pot, whereupon the shaft is rotated so that the pot will be carried to the draining position, the same action carrying to the drawing position the pot which had been draining and heating. Glass will be ladled or run into the pot which was brought to the drawing point after which the drawing and annealing apparatus is lowered until the lower end of the previously drawn sheet or section enters the bath of glass in the pot. The end of the sheet welds with the glass in the pot and the machinery is then operated to give a vertical movement to the sheet and draw the glass from the pot, the cycle of operations being repeated indefinitely.

Apparatus for Grinding, Smoothing and Polishing Glass, Plate Glass and Other Material Substances. U. S. 1,474,672. Nov. 20, 1923. Charles Heuze, of Ouvelais, Belgium.

This invention relates to apparatus for grinding, smoothing and polishing glass and similar materials.

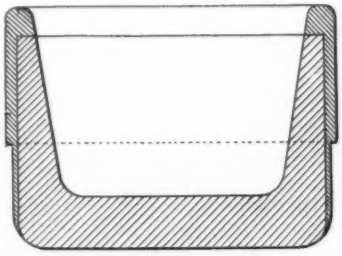




The inventor claims apparatus comprising a work - supporting table; a plurality of groups of tools, each group consisting of at least one row of tools extending above and across the table; a support individual to each row; mechanism connected to reciprocate all of the supports in all of the groups simultaneously but certain supports in different directions from others; mechanism for rotating a plurality of rows of tools simultaneously, but some of the tools in the opposite direction from others; and means for imparting a progressive forward movement to the table, to carry the work from one group of tools to the next.

Glass-Melting Pot. U. S. 1,475,650. Nov. 27, 1923. Frank Osborne, of Ford City, Pa., assignor to Pittsburgh Plate Glass Company.

This invention has for its principal object the provision of a pot especially adapted to withstand unusually severe heating and to give longer service than the ordinary plate glass pot.

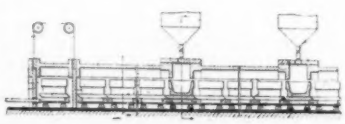


The inventor claims an open top plate glass melting pot provided with an annular shoulder and having a body portion of pot clay, and a rim and an outer shell for the body portion of a clay which is more refractory than that of the body portion, such shell extending down from the rim to a point below the shoulder of the pot.

The manner in which the two clays are combined in the pot will be seen by reference to the drawing.

Method of Melting Glass in Pots. U. S. 1,476,431. Dec. 4, 1923. Frank E. Troutman and Charles H. Christie, of Butler, Pa.

This method of melting glass in pots consists in preheating the pots, introducing them into a heating chamber, moving the pots through said chamber, maintaining the temperature in said chamber as the pots move through same whereby the glass is melted and fined, and admitting batch to said pots at intervals in their passage through said heating chamber, the said pots being introduced into



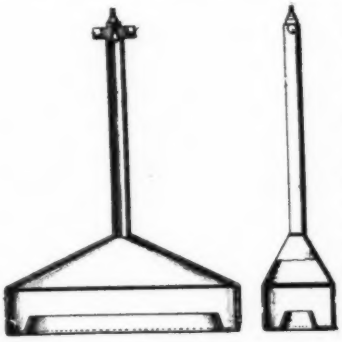
said heating chamber and removed therefrom without exposing said chamber to the outer air.

Glass-Melting-Pot Furnace. U. S. 1,476,432. Dec. 4, 1923. Frank E. Troutman and Charles H. Christie, of Butler, Pa.

This invention relates to a glass melting pot-furnace, and more particularly to a furnace adapted for melting glass in pots for the manufacture of plate-glass by the method covered by U. S. Patent 1,476,431.

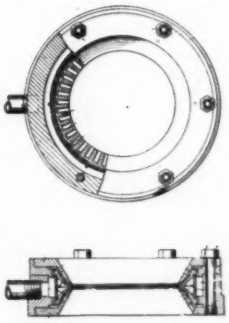
Blowpipe for Glass-Making Apparatus. U. S. 1,472,291. Oct. 30, 1923. John Carmany Campbell, of Clarksburg, W. Va.

Practically all drawing baits in use at the present time are of cylindrical formation. Consequently the glass drawn by them is in the form of a tube or cylinder. It is a well known fact that in forming these glass cylinders, the bait, which is mounted for vertical movement is lowered down into the molten glass which is contained in a suitable receptacle, and, as the bait includes a channel or pocket at its lower end, upward movement thereof will carry a quantity of glass, in the form of a cylinder, with it. Suitable air supply means is employed for cooling and shaping the cylinder and maintaining a uniform diameter. Because of this cylindrical formation of the glass, it is necessary before making the same into flat plates, to put it through a process known as "flattening." This procedure is necessarily very expensive, due to the added time it consumes and the mechanical skilled laborers it requires to carry it out.



Gas Burner. U. S. 1,476,184. Dec. 4, 1923. Ernest C. Schrader, of Toledo, O., assignor to the Libbey Glass Manufacturing Company, of Toledo, O.

This invention relates to gas burners of the type adapted to emit gas under high pressure, and intended more particularly for use in the manufacture of glassware to burn off or fire finish portions of the same. The object of the invention is the provision of a burner of the class described which is simple and efficient in its operation, and which includes a novel and important arrangement of pilot-light orifices for the discharge of low pressure gas in combination with a series of orifices for the discharge of high pressure gas, whereby to enhance the practicability and commercial value of burners of this character.

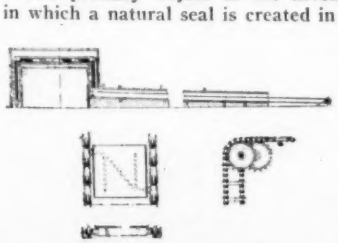


Lehr for Annealing Glassware. U. S. 1,474,058. Nov. 13, 1923. David Stenhouse, of Clarksburg, W. Va.

The primary object of the invention is to provide a lehr in which a natural seal is created in the portion thereof which carries the maximum temperature, thereby obviating the necessity for employing doors or other heat-confining means.

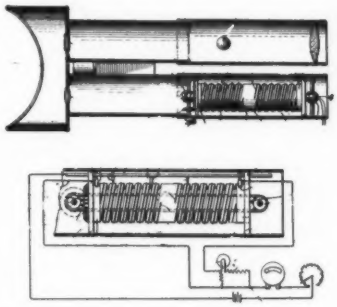
A further object is to provide a lehr in which, during the return of the conveyor or ware-carrying medium to the charging point, said conveyor is preheated to a temperature approximately the charging temperature of the ware, largely ultilizing for this purpose waste heat given up by the ware and the advancing portion of the conveyor in passing to and through the cooling chamber of the lehr, the purpose being not only to prepare said conveyor for the reception of the ware but also to effect the preheating without material increase in fuel consumption, or by means of reclaimed heat.

Another object is to provide a lehr which may have its charging end located closely adjacent to the ware-forming machine or machines without materially reducing or interfering with factory floor space, permitting the employment of carrying-in boys and lehr feeding devices heretofore required to be wholly dispensed with.



Optical Pyrometer. U. S. 1,476,486. Dec. 4, 1923. Richard P. Brown and Charles P. Frey of Philadelphia, Pa., assignor to the Brown Instrument Company, of Philadelphia, Pa.

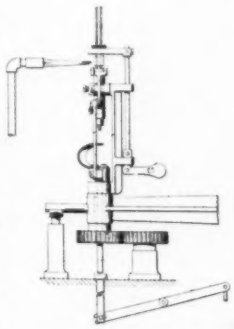
Some of the objects of the present invention are: To provide an optical pyrometer with means for reading temperature equivalents without removing the instrument from its operative position; to provide means to standardize a current so that its value has a direct relation to the indications of a temperature equivalent scale; to provide means for varying the light standard of an optical pyrometer and simultaneously maintain the current constant; to provide means for maintaining an electrical balance in an optical pyrometer; to provide means for synchronizing the movement of a movable scale with respect to the movement of an element by which the intensity of the standardizing light is varied; to provide means for eliminating minor errors due to differences between different light standards of the same type, where one is substituted for the other in an optical pyrometer; and to provide other improvements as will hereinafter appear.



Apparatus for Treating Glass. U. S. 1,472,456. Oct. 30, 1923. Albert Boardman, of Hamilton, Ontario, Canada, assignor to Western Electric Company, Incorporated, of New York, N. Y.

This invention relates to an apparatus for uniting metal and glass and particularly to that step in the manufacture of evacuated bulb structures, such as audions, which is concerned with the insertion of wires in the stem or press of the bulb.

In manufacturing stems or presses for the bulbs of electric instruments, it is the custom to support a flare within which the lead wires are properly positioned and then to heat a portion of the flare until it is sufficiently softened for the step of forming the press. Just before the formation of the press, an anchor wire is inserted into the softened portion of the flare so that when the press is formed it is sealed in the glass. Machines for performing this operation have heretofore comprised a movable member for projecting the anchor wire into position and jaws operable by the projecting member for forming the press. The relation between the projecting member and jaws is such that when the projecting member has reached its limit of movement, the jaws have also reached their limit of movement. Thus, should a flare be slightly undersize, the jaws may not be effective to form a tight seal. It is an object of this invention to provide an operable connection between the projecting member and the press forming jaws of such a character that a tight seal will always be produced regardless of the diameter of the flare.



Natural Gas in 1922

In 1922 there was consumed in the United States 762,546,000,000 cubic feet of natural gas, having an estimated value of $84,873,000 at the wells, and of $221,535,000 at points of consumption, according to data compiled by H. Backus and issued December 15 by the Department of the Interior through the Geological Survey. This is 15 per cent more than the quantity consumed in 1921 and 4 per cent less than that consumed in the record year, 1920.

Increased production is recorded for most of the States and in the leading five—West Virginia, Oklahoma, Pennsylvania, Louisiana, and California—gains were made, ranging between 8 and 20 billion cubic feet.

The interstate movement of natural gas increased from 150 billion cubic feet in 1921 to 179 billion cubic feet in 1922. West Virginia, which contributed 25 per cent of the total production and consumed only 10 per cent, contributed 66 per cent of the gas that was transported to other States.

During the past few years there has been a considerable increase in the unit value of natural gas, the average value at the points of consumption increasing from 21.6 cents per thousand cubic feet in 1919 to 29.1 cents in 1922. The average value of the gas used in domestic consumption increased more than 15 cents in the past four years and in 1922 was 49.9 cents.

Natural Gas Produced and Consumed in the United States in 1922

State	Produced and delivered to consumers including deliveries in other States: Quantity (M cubic feet)	Estimated value at the wells: Total	Average per M cubic feet (cents)	Consumed, including receipts from other States: Quantity (M cubic feet)	Value at points of consumption: Total	Average per M cubic feet (cents)	Interstate transportation: Quantity piped into the State (M cubic feet)	Quantity piped out of the State (M cubic feet)
Arkansas	9,700,000	$873,000	09.0	17,826,000	$3,306,000	18.5	8,126,000	.....
California	84,580,000	7,612,000	09.0	84,580,000	17,898,000	21.2	.....	.....
Colorado	4,000	400	10.0	4,000	560	14.0	.....	.....
Illinois	3,383,000	372,100	11.0	3,383,000	424,040	12.5	.....	.....
Indiana	947,000	284,100	30.0	3,263,000	1,641,000	50.3	2,320,000	4,000
Iowa	500	56	11.2	500	250	50.0	.....	.....
Kansas	20,289,000	1,826,000	09.0	28,348,000	10,315,000	36.4	12,811,000	4,752,000
Kentucky	5,872,000	646,000	11.0	15,268,000	4,884,000	32.0	9,396,000	.....
Louisiana	70,267,000	2,108,000	03.0	65,987,000	4,476,000	06.8	4,012,000	8,292,000
Maryland	.....	.....	...	705,000	472,000	67.0	705,000	.....
Michigan	700	78	11.1	700	350	50.0	.....	.....
Missouri	2,600	289	11.1	4,873,600	3,802,000	78.0	4,871,000	.....
Montana	486,000	24,245	05.0	486,000	88,300	18.2	.....	.....
New York	6,947,000	1,598,000	23.0	15,777,000	7,676,000	48.7	8,849,000	19,000
North Dakota	600	67	11.1	600	300	50.0	.....	.....
Ohio	51,481,000	9,267,000	18.0	116,127,000	55,062,000	47.4	68,200,000	3,554,000
Oklahoma	140,631,000	15,469,000	11.0	111,681,000	24,800,000	22.2	425,000	29,375,000
Pennsylvania	101,276,000	20,255,000	20.0	130,733,000	50,657,000	38.7	40,287,000	10,830,000
South Dakota	15,600	1,732	11.1	15,600	6,400	41.0	.....	.....
Tennessee	3,000	333	11.1	3,000	800	26.7	.....	.....
Texas	47,945,000	3,835,600	08.0	60,119,000	14,165,000	23.6	16,186,000	4,012,000
West Virginia	195,288,000	19,529,000	10.0	79,938,000	18,829,000	23.6	3,144,000	118,494,000
Wyoming	23,427,000	1,171,000	05.0	23,427,000	3,031,000	12.9	.....	.....
1922	762,546,000	$84,873,000	11.1	762,546,000	221,535,000	29.1	179,332,000	179,332,000
1921	662,052,000	.....	...	662,052,000	174,617,000	26.4	149,791,800	149,791,800

Summary of Statistics of Natural Gas, 1919-1922

	1919	1920	1921	1922
Quantity of natural gas consumed (M cubic feet):				
Domestic consumption	255,743,000	286,001,000	248,334,000	254,413,000
Industrial consumption:				
Carbon black	49,896,000	40,599,000	50,565,000	53,629,000
Field use	169,787,000	202,108,000	182,305,000	197,850,000
Other industrial	270,490,000	269,502,000	180,848,000	256,654,000
Total	745,916,000	798,210,000	662,052,000	762,546,000
Domestic	34.3 per cent	35.8 per cent	37.5 per cent	33.4 per cent
Industrial	65.7 per cent	64.2 per cent	62.5 per cent	66.6 per cent
Domestic consumers (approx.)	2,501,000	2,615,000	2,631,000	3,015,000
Value of natural gas at wells	.....	.....	.....	$84,873,000
Average value per M cubic feet	.....	.....	.....	11.1 cents
Value of natural gas at points of consumption	$160,888,000	$196,194,000	$174,617,000	$221,535,000
For domestic purposes	88,414,000	109,302,000	110,337,000	126,902,000
For industrial purposes	72,474,000	86,892,000	64,280,000	94,633,000
Average value per M cubic feet:				
For domestic purposes	34.6 cents	38.2 cents	44.4 cents	49.9 cents
For industrial purposes	14.8 cents	17.0 cents	15.5 cents	18.6 cents
Domestic and industrial	21.6 cents	24.6 cents	26.4 cents	29.1 cents
By-products of natural gas; Natural-gas gasoline:				
Quantity (gallons)	331,500,000	384,700,000	449,900,000	505,832,000
Value at plants	$64,197,000	$71,788,000	$61,815,000	$72,711,000
Average value per gallon	18.3 cents	18.7 cents	13.7 cents	14.4 cents
Carbon black:				
Quantity (pounds)	52,100,000	51,300,000	59,800,000	67,795,000
Value at plants	$3,816,000	$4,032,000	$5,446,000	$5,820,000
Average value per pound	7.3 cents	7.9 cents	9.1 cents	8.6 cents

The Glass World and What It Is Doing

News of the Industry

Libbey-Owens Sixth Annual Report

The annual report of President E. D. Libbey to the stockholders of the Libbey-Owens Sheet Glass Company for the fiscal year ending September 30, 1923, disclosed that this has been the company's most prosperous year. Following are abstracts from the report:

PLANT AND EQUIPMENT

During the year we enlarged four furnaces at Charleston so that each will supply two machines with glass. We now have five such double furnaces. A sixth furnace will be enlarged and should be ready for operation in connection with two machines by April next, making six double furnaces and six single furnaces operating in connection with eighteen machines. Two of these machines draw sheets of glass eighty-four inches wide, while the remainder draw sheets seventy-two inches wide. The double furnaces show a very satisfactory increase in production of glass of our customary high quality, with a marked economy in fuel consumption.

Factory production at Charleston throughout the year has been approximately ninety per cent of full capacity.

It is interesting to note that there were in operation in 1917, machines having a capacity of producing one million boxes of glass per year, while at present the machines installed at Charleston, Shreveport and Lancaster have a total yearly capacity of four million boxes.

Our experimental department during the year has developed a grinding and polishing machine which converts our heavy drawn sheet glass into polished plate glass. If no unexpected delays occur, we should have a commercial plate glass plant in operation before the close of next year.

SUBSIDIARIES

Last January your company took over the active management of the factory of its subsidiary, the United States Sheet & Window Glass Company, located at Shreveport, Louisiana, and in February the executive offices of that company were moved from Columbus to Toledo. The three double furnaces in that factory have, during the year, been rebuilt to conform to the latest practice and experience at Charleston, and its six machines are now in full operation. The United States Sheet & Window Glass Company is now making substantial profits and your company may expect to benefit from its operations through the royalties payable under its license and through your company's stock interest in this company.

A few changes, to conform to Charleston practice, have been made in the Lancaster plant of the Fairfield Sheet Glass Company, and that company is now making excellent glass and is showing a substantial profit.

For the reasons set out in our last annual report, the construction of a sheet glass plant at Toledo by The Toledo Libbey-Owens Sheet Glass Company, a subsidiary of your company, was postponed, and the company has since been dissolved. In its stead your company itself expects to erect at Toledo a plant for manufacturing, as well as grinding and polishing, our heavy sheet glass. For that purpose we have recently purchased in East Toledo, at the junction of the New York Central and Hocking Valley Railroads, one hundred and seventeen acres of land and plans for the erection of the first plate glass unit are now completed.

LICENSEES AND ALLIED COMPANIES

The factory of Compagnie Internationale pour la Fabrication Mecanique du Verre, at Moll, Belgium, in which your company owns a substantial interest, began drawing glass April 28, 1923, from one tank operating in connection with two eighty-four inch machines. The second tank with two machines began operation November 20. The remaining tank and two machines will commence operation about January 1. The product has found a ready sale, both for consumption in Belgium and for export. The operation of the coke oven plant has proved exceptionally remunerative on account of the enormous increase in the price of coke, due to the French occupation of the Ruhr. The Belgian Company is already showing a substantial profit.

The plant of the American-Japan Sheet Glass Company, which controls the use of our machines in Japan, was not injured by the recent earthquake. It continues to make a fine quality of glass which finds a ready market in Japan. The company is now making substantial profits.

The one machine plant of Compagnie des Verreries de Moutier, near Bale, Switzerland, started drawing glass August 6, 1923, and has every prospect of satisfactory operation and resultant profit. It is planned to add another machine as soon as results warrant.

The high cost of materials, together with the low selling price of its product, due to insufficient tariff protection and foreign competition, has forced a suspension of operation of the plant of the Canadian Libbey-Owens Sheet Glass Company, Ltd., at Hamilton, Ontario. The continued fall of the Belgian franc has tended to intensify foreign competition in Canada. It is expected that when the tariff situation will have been remedied and the franc stabilized, the Canadian plant will resume operation.

Compagnie Franco-Belge pour la Fabrication Mecanique du Verre, the licensee in France of the parent Belgian Company, has commenced the construction of a plant at St. Etienne, Department Le Marais, in Eastern France. One tank and two machines will be first installed and the factory will be enlarged and further tanks and machines installed later as developments may require. The location for a plant in northern France has not yet been determined but it is expected that decision will be reached and construction begun within a short time.

Compania Espanola para la Fabricacion Mecanica del Vidrio, the licensee in Spain of the parent Belgian Company, has commenced the construction of a factory at San Adrian del Besos, near Barcelona. Construction has been somewhat delayed and may be further delayed by the disturbed political and economic conditions in Spain.

INCOME AND EXPENSE STATEMENT

For the Fiscal Year Ended September 30, 1923

INCOME

Manufacturing Profit and Royalties After Deducting Cost of Sales and General Overhead	$4,237,928.90
Other Income	165,068.31
Total Income	$4,402,997.21
Less Foreign, Patent, Licensing, Experimental Expenses, Etc.	399,933.94
Profit Before Federal Taxes and Contingencies	4,003,063.27
Reserve for Federal Taxes and Contingencies (Estimated)	450,000.00
Net Profit to Surplus	$3,553,063.27

FINANCIAL

The net earnings of your company for the year, after deducting cost of experimental work and reserves for depreciation, repairs, taxes, doubtful accounts and various contingencies, are $3,553,063.27.

To capitalize the various improvements at Charleston, $2,000,000 par value of Preferred Stock was sold last Spring to the stockholders of your company at par and accrued dividends, the issue being oversubscribed more than a million dollars.

Cash dividends have been paid on the preferred stock during the year in the amount of $210,000, being the full seven per cent dividend on the $2,000,000 preferred stock originally outstanding and for two quarters on the $2,000,000 issued March 1, 1923, and in the amount of $400,000 on the outstanding $5,000,000 of common stock.

During the fiscal year our liquid or current assets have increased by $1,782,748.04. Permanent assets, such as buildings and equipment, have increased, after adequate depreciation, $1,401,167.10.

The New York *Journal of Commerce* reports that the Belgian subsidiary of the **Libbey-Owens Sheet Glass Company,** in its report of August 30, 1923, showed an increase in fixed assets of 22,532,790 francs over the figures as of August 30, 1922. This increase is said to be due largely to new construction and expansion especially in connection with the opening of the new plant at Gompel.

Libbey-Owens Stock Dividend

The board of directors of the Libbey-Owens Sheet Glass Company on December 12 declared a dividend of 50 per cent on the outstanding common stock of the company payable in common stock at par on January 10, 1924, to stockholders of record at 3 o'clock p. m., December 31, 1923.

Stockholders were informed at the annual meeting that present 8 per cent cash dividend will be continued on all stock, which is equivalent to 12 per cent on present holdings.

The stock dividend means distribution of $2,500,000 of $25 par value common stock to present holders of $5,000,000 common outstanding.

A Remarkable Catalog

To designate the new 400-page Pittsburgh Plate Glass Company's publication "Glass, Paints, Varnishes and Brushes" as a catalog is to fall far short of describing it adequately, for while this handsome volume does include a comprehensive and complete compilation of the company's manufactures, it contains also a wealth of other information concerning the history and manufacture of the products made in its factories and their uses in many fields. It outlines the establishment and development of the Company, whose history, pointed out in the introduction, is largely the history of the American plate glass industry itself. It describes with many interesting illustrations the process by which plate and window glass, paints and brushes are made. It supplies valuable data for the users of these products. An enormous amount of time and work has been put into the collection, preparation and compilation of the material the volume contains. Every page gives evidence that the same kind of painstaking effort characteristic of all the Company's activities has been given to its production, with the natural result that a publication of extraordinary quality has been made available.

The book is bound in stiff buckram covers and the printing and paper and illustrations leave nothing to be desired. Starting with a short article on "The Romance of Glass" followed by "The History of Glass," the Manufacture of Glass is then taken up at the starting point—the sand mine—and all the processes from the making of melting points to the final finishing operations are described and most of them elaborately illustrated. Many examples of the extensive use of glass in modern buildings are given. The history, manufacture and the many uses of mirrors are set forth. Plate glass in the automobile and furniture trades is covered. Many pages are devoted to plate glass store fronts. Numerous photographs of modern store front installations are reproduced, and diagrams of suggestive designs for others are shown. The advantages of displacing antiquated show cases for displaying merchandise with modern plate glass equipment are featured. The uses and possibilities for plate glass in scores of other places such as restaurants, banks, on shipboard, in manufactured articles such as adding machines, scales, etc., are referred to. Ground, sand-blasted, chipped, enameled, embossed and etched glass and their uses are discussed. Prism glass and its influence on lighting problems is explained. Methods of making wire mesh and ornamental glass are described. Interesting discussions on leaded and stained glass are included, accompanied by illustrations of a number of examples of their use, well-executed in colors. The many uses of carrara and black glass are given special attention.

A splendidly illustrated account of the cylinder process of manufacturing window glass occupies several pages. Grades, weights and sizes of window glass and other useful and interesting data on window, plate and other glass is given. The Company's system of distribution, education, and service are described. Tables of maximum sizes, thicknesses and weights are shown.

The second part of the book, consisting of 178 pages is devoted to products of the Pittsburgh Plate Glass Company other than glass. Paint, its origin, first uses, commercial development and manufacture are gone into at length. Varnish is treated similarly. An elaborate insert of color cards is reproduced and show the colors of numerous paints, varnishes, enamels and stains manufactured by the Company. Advice on the use of the products is given and many suggestions for color schemes for both interior and exterior application are shown by colored plates.

Brushes, their origin and history, the development of the brush industry and brush manufacturing methods are interestingly described and illustrated.

The final pages of the catalog are given over to describing numerous specialties, sundries and supplies provided for the glazing, painting and paperhanging trades.

All in all, this mammoth volume, the quality and size of which has seldom, if ever, been equalled by the catalogs of manufacturing concerns in any line of business in the United States, will serve to give the average reader a much more adequate idea than he previously held as to the enormous activities and extensive interests of highly progressive concern.

Window Glass Agreement Held Valid

As announced through the daily press of December 10, the appeal of the National Association of Window Glass Manufacturers and the National Window Glass Workers' Union and others from the decision of the Federal district court of Northern Ohio, which held them guilty of having in violation of the Sherman Anti-Trust Law entered an agreement relating to wages and working agreements which had the effect of restraining interstate commerce, was granted by the United States Supreme Court and the appeal held to be valid and not in restraint of trade. The setting aside of the injunction granted by the Ohio Federal court brought great satisfaction to the window glass industry.

The suit had been regarded by Government counsel as one of the most important proceedings begun in recent years under the Sherman Anti-Trust Law, the Government having attacked the agreement as constituting restraint of trade in curtailing production of hand-blown window glass and restricting its distribution in interstate trade and commerce. The agreement prescribes the periods of time during which the hand-blown window glass factories shall operate. The workers agreed to this provision on the ground that shortage of labor prevented the factories from all working at the same time.

It is believed that the Court's decision influenced the settlement, announced on December 29, of the differences prevailing between the manufacturers and workers as to wages and that a number of hand factories will soon go into operation.

Two-Year Wage Agreement Assured

Two years peace in the building trades of the Metropolitan district is almost an assured fact. Nearly every union in the New York Building Trades Council affiliated with the American Federation of Labor has signed an agreement with the employers. Unions representing half the membership of the old Building Trades' Council have negotiated agreements with employers. Approximately 65,000 of the 115,000 workers in the building trades are employed under one or two year contracts, the majority under the longer term agreement.

The seven trades which have signed agreements with the employers are the carpenters, hoisting engineers, machinists, sheet metal workers, tile layers, art glass workers and glaziers.

The carpenters, sheet metal workers and tile layers received an advance of 50 cents a day beginning January 1 on a two-year contract. The art glass workers get $9 and glaziers $10. The helpers in the various trades will get $8 a day, the present scale and bonus wage.

There may be a flurry in one or two trades but nothing of a nature calculated to upset peace prospects is looked for.

Damages Suffered by Tokio Glass Factories

The fire which followed the earthquake of September 1 in Japan caused enormous damage among the glass factories of the Tokio district. Accurate estimates of losses have not been issued but our Tokio correspondent, after a personal investigation, reports that of 212 glass factories, 160 were destroyed, and of 125 glass trading concerns, 116 were burned out. Thus over 80 per cent of the factories and warehouses were ruined by fire and most of the remaining glass plants had been badly damaged by the earthquake.

Much sorrow was caused throughout the industry by the death of Mr. Itonaga, well-known manufacturer of pressed glassware, who, with his family, was killed the night of the fire.

However, after three months have passed, smoke is again issuing from stacks in Honjyo, the famous glass production district; various factories led by the bottle works, having effected repairs and resumed operations.

Gas Producers in Glass Factories

Figures showing the number of Morgan gas producers in use in the glass industry were contained in a statement made recently by E. A. W. Jefferies, manager of sales for the Morgan Construction Company, Worcester, Mass., who gave the list of complete Morgan producers in use December 6, 1923, in this field, as follows:

	Machines
Corning Glass Works, Corning, N. Y.	8
Edison Lamp Works, Ft. Wayne, Ind.	2
Hazel-Atlas Glass Co., Grafton, W. Va.	2
Macbeth-Evans Glass Co., Charleroi, Pa.	4
National Lamp Works, Cleveland, O.	6
National Plate Glass Co., Ottawa, Ill.	13
Edward Ford Plate Glass Co., Rossford, O.	8
Owens Bottle Company, Fairmont, W. Va.	1
Total in United States	44
British Thomson-Houston Co., England	2
British Window Glass Co., Ltd., England	3
Forster's Glass Co. Ltd., England	2
Lancashire Automatic Glass Mfg. Co., England	2
Total in England	9
Total in France	4

During 1923 ten machines were bought by the National Plate Glass Company, Ottawa, Ill., and eight by the Edward Ford Plate Glass Company, Rossford, O.

Wage Settlement Accomplished

An agreement to continue last year's wage scale with minor changes was reached on December 29 after a conference at Cleveland, O., between the wage committee of the National Association of Window Glass Manufacturers and the National Association of Window Glass Workers. The scale is reported to be 84 cents for single strength and $1.16 for double strength. The employes agreed to permit the manufacturers to cut 20 per cent in fourth quality, but no fourth quality is to be cut in the first bracket.

Window Glass Manufacturers Elect President

At a special meeting of the National Association of Window Glass Manufacturers held on December 12, George A. Schlossstein, of Charleston, W. Va., was elected president to succeed W. S. Phillips of Brownsville, Pa., whose resignation was accepted. J. R. Johnston, Jr., of Pittsburgh, was elected secretary and treasurer.

Metropolitan Museum Industrial Exhibition

The Metropolitan Museum of Art which for several years has been making determined and increasingly successful efforts to induce manufacturers to take more interest in the artistic value of their products, has invited leading manufacturers of china, glassware, silverware, jewelry, furniture, rugs, textiles, and other goods susceptible to improvement from the artistic point of view, to show specimens of their best stock designs at the Annual Exhibition of Industrial Art to be held at the Museum in New York January 14 to March 2, 1924.

Entry requirements specify that the design shall be of a caliber approved by the Museum; the design shall be made in America; and the exhibit manufactured in America during the year 1923. These exhibits must also represent "quantity production," that is, not special orders or isolated examples, but goods manufactured for stock. The term will be construed to cover also pieces produced singly but as duplicates of an identical design.

The Metropolitan Museum of New York has received, as the bequest under Lord Carnarvon's will, a wonderful glass vase of the 18th Dynasty, dating from 1500 B. C.

Glass Division at Atlantic City Convention

At the annual convention of the American Ceramic Society, February 4-9, 1924, at Hotel Traymore, Atlantic City, N. J., one day will be given over to general ceramic subjects, and two days will be occupied with separate meetings of the seven divisions of the Society, including that of the Glass Division at which papers on various subjects will be read and discussed. The annual banquet will be held as usual. Railroads have promised a special fare of one and one-half times regular one-way rate.

Pittsburgh Glass and Pottery Exhibition

The annual exhibition of glass and pottery at Pittsburgh will open January 7 under the auspices of the Associated Glass and Pottery Manufacturers and will continue until January 26. J. M. Hammer of Pittsburgh, is secretary and show manager.

Census Bureau Needs Co-operation

The second biennial census of manufacturers authorized by Congress in 1919 will cover the year just closed. Schedules were mailed to manufacturers on January 2.

The Director of the Census is very anxious to publish the statistics at the earliest possible date in order that they may be of the greatest possible commercial value. Glass manufacturers are urgently requested to forward their reports to the bureau at the earliest possible date, preferably before the end of January. The bureau has agreed to tabulate the results for our industry as rapidly as the schedules are received and publish the totals within a few days after the receipt of the last report.

New Publications

Insulation. A 62-page booklet just issued by the Armstrong Cork and Insulation Company, Pittsburgh, Pa., points out that insulation of pipes and heated surfaces, instead of being, as formerly, a neglected or incidental detail, often left to the discretion of an uninformed foreman, is now recognized as one of the vital factors in plant equipment, to be worked out on an efficiency basis by the engineer and insulation specialist.

The properties of Nonpareil high pressure insulating pipe coverings and blocks are described and heat loss and efficiency tables are given for pipe from ½-inch to 30-inch diameter and for various temperatures and varying thickness of insulation. Numerous applications of Nonpareil insulating material to different industries are illustrated.

Coming Meetings

The Pittsburgh, Pa., Exhibition of Glass and Pottery will be held January 7 to 26, 1924.

The next annual meeting of the American Ceramic Society will be held at Atlantic City, N. J., February 4 to 9, 1924.

The Chicago Fixture Market and the annual convention of the National Association of Lighting Equipment Dealers will be held at the Hotel Sherman, January 21 to 26.

The next annual meeting of the National Ornamental Glass Manufacturers' Association of the United States and Canada will be held at New York, June 24 to 26, 1924.

Society of Glass Technology, S. English, secretary, announces meetings for 1924 as follows: January 16, Manchester; February 20, Sheffield; March 19, Stourbridge; April 16, Sheffield (annual general meeting); May 21, London and June 18, Sheffield. Details of programs will be announced a week prior to each meeting.

Verified News of Trade Activities

The Independent Glass Co., Inc., has been incorporated at Wilmington, Del., to manufacture and sell glass. The capital is $3,000,000.

The Maryland Glass Company, Cumberland, Md., has obtained permission from the State Tax Commission to increase its capital stock to $250,000.

The Lewis County Cut Glass Company, Weston, W. Va., has been incorporated with a capital of $25,000 by Ray C. Lorentz, William Webber and others.

The Lima Glass Company, jobbers, Pearl and Union streets, Lima, O., has awarded a contract for a new plant at Green and Sawyer streets, to cost about $50,000.

The S. & L. Glass Company, New York has been incorporated with a capital of $10,000 by A. Teplitz, B. and M. Goff. Attorney, A. Midonick, 299 Broadway, New York.

The Variety Glass Products Company, manufacturers of opal towel bars and pressed ware, Clifton, N. J., is doubling the capacity of its plant by installing a second day-tank.

The Independent Glass Manufacturing Company, Inc., has been incorporated at Wilmington, Del., to manufacture and sell all kinds of glass. The authorized capital is $3,000,000.

The Bienenfeld Glass Works, Brooklyn, N. Y., has been incorporated with a capital of $75,000 by H. L. and M. and S. Bienenfeld. Attorney L. C. Wills, 32 Court St., Brooklyn, N. Y.

Trial of the **American Window Glass Company** and others indicted in March, 1922, for violation of the Sherman anti-trust law has been set by Federal Judge Goddard for January 15.

The West End Glass Company, Brooklyn, N. Y., has been incorporated with a capital of $15,000 by A. Shevach, S. and R. Fisher. The company's attorney is H. Halpern, 232 Greenwich St., New York.

It is reported that construction work on the new plant of the **Pittsburgh Sheet Glass Company** at Tylerdale, near Washington, Pa., is progressing satisfactorily and that manufacturing operations will begin early in the Spring.

The Liberty Mirror Works, Inc., Brooklyn, N. Y., has been formed to manufacture glass, etc. Capital, $3,000. Incorporators include: Nathan Zahn, 2102 Dean street, and Harry Engelhart, 472 Watkins street, Brooklyn, N. Y.

Reconstruction is under way of the white liner tank at the factory of **Ball Bros. Glass Company,** Muncie, Ind., which burst, letting down 65 tons of glass and caused a serious fire in which the roof of the building was destroyed and considerable other damage done.

The Clarksburg Glass Company, Clarksburg, W. Va., is changing over its plant from hand to machine methods by the installation of eight Fourcault sheet glass drawing machines. The plant is being made ready for the machines and the contract for the construction of them has been let.

The Automatic Machinery Company, Terre Haute, Ind., manufacturers of automatic lehr loaders and conveyors, and specialists in glasshouse equipment, has been granted a patent in Germany on its conveyors and lehr loaders, the patent having been applied for on June 18, 1920, and granted November 9, 1923.

The china, pottery and glassware firm of L. Straus & Sons, 44-46 Warren street and 116 Chambers street, New York, established in 1866, has been dissolved as of November 30, 1923. Nathan Straus, Jr., has purchased the business which will be taken over by a new corporation known as **Nathan Straus & Sons, Inc.**

The Pacific Glass Company has been organized at Augusta, Me., to deal in paint, glass and oil; capital stock, $500,000, of which $250,000 is common and $250,000 preferred; nothing paid in; par value of preferred shares, $100, and common, $1; eight common shares subscribed; directors, President, E. M. Leavitt; treasurer, E. F. Porter; Frank E. Southard and Ernest L. McLean, all of Augusta.

At a meeting of the stockholders of the **Stark Glass Company,** at Massillon, O., on December 8, authorization was given to incorporate a $1,000,000 corporation with the object of taking over the plant of the Rhodes Bottle & Glass Company, remodeling and operating it with Winder-Daubenspeck machines. The incorporation committee includes: C. E. Suart, E. H. Birney, H. S. Potter, H. C. Daubenspeck and W. E. N. Hemperly.

The board of directors of the **Belmont Tumbler Company,** Bellaire, O., at a recent meeting declared a 33⅓ per cent stock dividend, this latest issue bringing the total stock dividends up to 100 per cent, all stockholders now owning double the amount of stock for which they originally subscribed. The board also declared the quarterly, 2 per cent cash dividend, which has been paid regularly since the company was organized about eight years ago. Harry A. Neff is president and R. C. Faris, secretary.

The Vidriera Andaluza, S. A., at Seville and the **Vidriera Gallega, S. A.,** at Vigo, the only two Spanish bottle works having completely automatic machinery for bottle manufacture resumed operations in November. The first mentioned company started their plant early in 1923 and after working a short time were compelled to close down due to the furnace breaking at the bridge. The Vidriera Gallega just completed the remodeling of the works, including the installation of oil-burning for the furnace and lehrs.

The Baltimore Decolorizer Company, 3405 Clifton avenue, Baltimore, Md., has been organized by H. A. Richards, formerly purchasing agent for the Carr-Lowrey Glass Company and George O. Smith, glass technologist, who was also until recently connected with the Carr-Lowrey company. The new company will furnish specialties for glass manufacturers, including "Clearwite" decolorizer, "Standard" cobalt compound and Tennessee feldspar. Formulæ for flint and colored glass in tanks and pots will be furnished, batch materials tested and the members of the company will act in an advisory capacity to glass manufacturers in making high grade glass in tanks and pot furnace. Supervision will be given to the manufacture of glass and tests conducted on raw materials used in the batch. Their specialty is the production of colorless glass in tank furnaces.

At a recent meeting of the stockholders of the **National Glass and Lens Company,** Lancaster, O., which was recently organized, the following directors were elected: Albert Steiner, C. S. Hutchinson, Fred Von Stein, Charles D. Martens, and Frank E. Smith. The officers elected included: Albert Steiner, president, who was formerly general manager and secretary of the Lancaster Lens Company, and has had wide experience in the manufacture of lenses and other glass products; Charles Hutchinson, vice-president; J. L. Graham, treasurer; and Fred Von Stein, secretary and sales manager. Mr. Von Stein has also been in the glass business for over twenty years and is familiar with the manufacturing and selling end. The company will make a complete line of ground and polished lenses of all kinds, including semaphore lenses, bull's eye lenses and blanks of all kinds for grinding and polishing, also other pressed and blown ware including reflectors and shades, decorated ware, and colored glasses of all kinds. The H. L. Dixon Company, Pittsburgh, Pa., is installing the equipment.

Personal Items

O. M. Byers was recently appointed assistant superintendent of the No. 2 plant of the American Window Glass Company at Jeannette, Pa.

L. E. Stewart, formerly assistant manager of the Bellevernon, Pa., plant of the American Window Glass Company, is now with the United States Window Glass Company, Morgantown, W. Va.

Warren Hires Turner has resigned as officer and director of the Hires Turner Glass Company, Philadelphia, Pa., so that he may devote his entire attention to the Standard Plate Glass Corporation of which he is vice-president and treasurer. The Standard Plate Glass Corporation, organized last Summer, represents a merging of the Standard Plate Glass Company, founded in 1887, and the Heidenkamp Plate Glass Company, established in 1900. The new corporation has plants in Butler and Springdale, Pa., where they produce polished plate glass for the automobile, building, mirror and furniture trades.

Recent Deaths

Robert H. McC. Potter

Robert H. McCarter Potter, sixty-five years of age, for many years a glass manufacturer in Hoboken, N. J., and Chicago, died recently in New York.

H. C. Northwood

H. C. Northwood, connected with the H. Northwood Company, Wheeling, W. Va., died in Cincinnati, O., on December 3, following an operation for appendicitis. He is survived by his widow, his mother and a sister.

Michael J. Owens

Michael J. Owens, inventor of the Owens automatic bottle machine and vice-president of both The Owens Bottle Company and the Libbey-Owens Sheet Glass Company, died suddenly in his office at Toledo, O., on December 27. He was almost 65 years old. A portrait of Mr. Owens appears on page 9 of this issue.

Sidney B. Whitlock

Sidney B. Whitlock, widely known throughout the trade, and for 30 years eastern representative of the Hazel-Atlas Glass Company of Wheeling, W. Va., died on December 10, in the Polyclinic Hospital in New York City, after an operation.

James B. McDowell

James B. McDowell, son-in-law and business partner for many years of the late John A. Brashear, famous astronomer and lens manufacturers, was found dead on the morning of November 28 at his laboratory workshop, Pittsburgh, Pa. At the time of his death he had almost completed a large lens for the Yale Observatory in which he was especially interested and which of all the important lenses he had produced was considered his masterpiece. Mr. McDowell was 63 years of age.

William W. Heroy

William W. Heroy, aged 70, a director of the Pittsburgh Plate Glass Company and for many years prominent in the plate glass industry, died in his home, Stamford, Conn., on December 26. In 1897 Mr. Heroy was president of the National Association of Glass Jobbers. Later he was president of the Societe Anonyme des Glaces de Courcelles, Belgium. The Pittsburgh Plate Glass Company purchased this factory which was destroyed by the Germans during the World War and has since been rebuilt.

Thomas Evans

Thomas Evans, 81 years old, president of the Macbeth-Evans Glass Company, Pittsburgh, Pa., died on December 8, at the Hotel Schenley, where he made his home. Mr. Evans, who was engaged in the glass industry throughout his business life, began making lamp chimneys in 1869, continuing at the head of his own company for 30 years. This company was later merged into the Macbeth-Evans Glass Company. He was one of the charter members of the American Association of Flint and Lime Glass Manufacturers which was organized in 1872 of which he served as treasurer for twenty years and in 1912 was elected president. Mr. Evans was elected president of the Macbeth-Evans Company following the death of George A. Macbeth in 1916. He is survived by two sons, Howard S. Evans, vice-president of the Macbeth-Evans Company, and T. Raymond Evans, president of the Diamond Alkali Company, a brother and a sister.

Inquiries Received

For further information address THE GLASS INDUSTRY

166. We would like the names of firms which can install an oil burning system to be used in connection with a day tank. (Dec. 14.)

167. Can you advise who manufactures machines for making flat glass, also blowing machines? (Dec. 11.)

168. Can you give us the address of the manufacturers of the Geist burner? (Dec. 7.)

169. Kindly refer us to a firm that manufactures machinery for making glass tubing and also for making small vials or bottles from glass tubing. We have two inquiries from foreign customers for such machines. (Dec. 5.)

170. We would like to get in touch with concerns that can furnish glass jars suitable for honey. We prefer eight or sixteen ounce clear glass jars with gold lacquered wax lined screw tops. (Dec. 1.)

171. Please give us the names of some consulting glass factory engineers. (Dec. 1.)

172. Can you give us the address of a concern that makes Queen Anne table glassware. (Dec. 17).

173. We would appreciate it if you would inform us who manufactures the Frink decolorizer for ordinary flint glass in tanks.

174. We use about ten tons of 7/16 inch lime cane per year and would like to secure the addresses of cane manufacturers—both machine and hand drawn (Dec. 29).

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

PITTSBURGH STOCK EXCHANGE, DECEMBER 21, 1923

	Bid	Ask	Last
American Window Glass Machine, common ...		94	95
American Window Glass Machine, preferred ...		94½	94½
American Window Glass Preferred.....	108½	..	108½
Pittsburgh Plate Glass.....	213	214	215
U. S. Glass.....	24	25	24¼

The Pittsburgh market has been rather quiet during the last month, with the possible exception of U. S. Glass, which has been fairly active between 23 and 24. Pittsburgh Plate Glass is quoted ex dividend 2%. It is the general impression that when earning statements are made public after the close of the year, a very satisfactory showing will be made by all the companies.

WHEELING STOCK EXCHANGE, DECEMBER 21, 1923

	Bid	Ask	Last
Hazel-Atlas	35	36	35½
Imperial Glass	90	93	95
Fostoria Glass	140	..	140
Central Glass	105	110	110

Although the Wheeling Market has been rather inactive, still the buying has been of good character. Central paid a 1% special dividend in addition to the regular disbursement of 2%. Hazel-Atlas declared the regular dividend and those interested in the glass issues are awaiting reports showing operations for the past year. It is said that the local companies will practically all show a record business for 1923.

TOLEDO STOCK EXCHANGE, DECEMBER 21, 1923

	Bid	Ask	Last
Owens Bottle Machine, common	42¾	43¼	43
Libbey-Owens Sheet Glass, common.....	136	139	136
Libbey-Owens Sheet Glass, preferred.....	105	108	107

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers

December 21, 1923

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	.06½	.07
Antimony oxide (Sb_2O_3)	lb.	.07½	.08½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.14	.14½
Barium carbonate ($BaCO_3$) (precipitated)	ton	70.00	85.00
Barium hydrate ($Ba(OH)_2$)	lb.	.05	.05½
Bone ash	lb.	.06	.07½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.05½	.06
Borax, fused ($Na_2B_4O_7$) any mesh	lb.	.19	.20
Boric acid (B_2O_3), fused	lb.	.35	.35
Cadmium Sulphide (CdS)—			
Red	lb.	..	1.65
Orange	lb.	..	1.45
Yellow	lb.	..	1.65
Chrome Oxide (Cr_2O_3)	lb.	.35	.36
Cobalt Oxide (Co_3O_4)—			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide—			
Red (Cu_2O)	lb.	..	.20
Black (CuO)	lb.	..	.25
Black prepared	lb.	..	.30
Cryolite (Na_3AlF_6)	lb.	..	.09⅛
Feldspar—			
100 mesh	ton	11.00	24.00
80 mesh	ton	..	24.00
40 mesh	ton	..	..
Ferrous oxide (FeO)	lb.	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	50.00
Powdered white, 90%	ton	38.00	45.00
Hydrofluoric acid (HF) 60% (in lead carboys)	lb.	..	.13
Kaolin (f.o.b. mine)	ton	9.00	..
Lead Oxide (Pb_3O_4) (red lead)	lb.	.11	.11¼
Litharge (PbO)	lb.	.10½	.11½
Lime—			
Hydrated ($Ca(OH)_2$) (in 50 lb. paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls. per bbl.		2.15	2.30
Magnesium carbonate ($MgCO_3$)	lb.	..	.09
Manganese 85% (MnO_2)	lb.	.03½	.04
Nickel oxide (Ni_2O_3), black, for nickel content	lb.	.32	.45
Nickel monoxide (NiO), green, for nickel content	lb.	.30	.50
Potassium carbonate—			
Calcined (K_2CO_3) 90%	lb.	.06¼	.06¾
Hydrated (KOH) 90%	lb.	.06¾	.07¼
Potassium nitrate (KNO_3) (gran.)	lb.	.06½	.06¾
Potassium Permanganate ($KMnO_4$)	lb.	..	.17
Powdered blue	lb.	..	.26
Standard formula	lb.	..	.38
Salt cake, glassmakers (Na_2SO_4), f.o.b. works	ton	26.00	35.00–40.00
Selenium (Se)	lb.	..	2.10–2.85
Soda ash (Na_2CO_3) dense, 58%— f. o. b. works.			
Bulk	Flat 100 lb.	1.40	..
Bulk, on contract	Flat 100 lb.	1.35	..
In 400 lb. bbls., on contract	100 lb.	1.69	..
In 300 lb. bags, on contract	100 lb.	1.45	..
Spot orders .05 per 100 lbs. higher.			
Sodium nitrate ($NaNO_3$), refined	lb.	.04¼	.04½
Sodium selenite (Na_2SeO_3)	lb.	1.90	2.00–2.50
Sodium Fluosilicate (Na_2SiF_6)	lb.	.07¼	.08
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.25	3.55–3.80
Flowers, in bags	Per 100 lb.	3.00	3.30–3.55
Flour, heavy, in bbls.	Per 100 lb.	2.50	2.80–3.05
Uranium oxide (UO_3), 100 lb lots	lb.	..	2.25
Zinc oxide (ZnO)	lb.	.06¾	.07

Monthly Summary of United States Foreign Commerce in Glass

Exports

Corrected to November 22, 1923

	October 1922 Quantity	October 1922 Value	October 1923 Quantity	October 1923 Value	Ten Months Ending October 1922 Quantity	Ten Months Ending October 1922 Value	Ten Months Ending October 1923 Quantity	Ten Months Ending October 1923 Value
Glass and glass products (total)	.....	$770,771	.....	$904,125	.....	$7,067,036	.....	$9,183,786
Plate and window glass—								
Window glass, common, box 50 sq. ft.	3,212	16,846	2,500	15,171	28,782	153,081	36,903	201,404
Plate glass, unsilvered, sq. ft.	222,375	89,398	76,191	51,596	2,415,253	1,002,897	1,767,330	765,063
Other window and plate glass, n. e. s. lbs.	204,691	26,235	241,728	20,273	1,626,619	188,011	2,998,046	334,771
Glass containers (bottles, vials and jars) lbs.	4,268,043	208,068	6,141,814	287,910	34,475,638	1,877,699	62,715,207	2,975,130
Table glassware, plain lbs.	1,521,516	173,278	1,794,834	178,245	10,319,141	1,140,298	17,000,161	1,859,553
Table and other glassware, cut or engraved lbs.	55,224	19,027	37,711	20,018	367,684	137,160	470,774	180,874
Glassware for lighting—								
Lamp chimneys and lantern globes lbs.	108,185	19,351	154,279	32,119	1,162,852	237,878	1,644,973	323,037
Globes and shades for lighting fixtures lbs.	120,111	40,089	195,624	51,775	1,226,725	354,186	1,282,827	386,826
Lamps and other illuminating devices, chiefly of glass lbs.	72,436	25,426	121,778	34,128	898,760	318,158	1,281,020	331,781
Chemical glassware lbs.	16,009	12,114	35,780	19,922	237,855	129,889	205,938	143,566
Electrical glassware, except for lighting lbs.	224,989	15,976	95,467	13,238	1,835,882	140,035	2,301,360	154,115
Other glassware, n. e. s. lbs.	691,433	124,963	870,133	179,730	10,774,678	1,387,744	8,624,374	1,527,666

Imports

Corrected to November 22, 1923

	October 1922 Quantity	October 1922 Value	October 1923 Quantity	October 1923 Value	Ten Months Ending October 1922 Quantity	Ten Months Ending October 1922 Value	Ten Months Ending October 1923 Quantity	Ten Months Ending October 1923 Value
Glass (total)	.....	$1,816,497	.....	$2,696,578	.....	$11,071,666	.....	$20,895,213
Cylinder, crown, and sheet, lbs. dut.	.....	.....	.....	.....	[1]41,597,241	[1]2,085,182	.....	.....
Unpolished, lbs. dut.	3,541,689	141,621	2,772,170	149,845	[2]3,541,689	[2]141,621	41,554,803	1,833,550
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	72,284	.....	62,695	.....	[2]72,284	.....	670,448
Plate glass—								
Unsilvered, sq. ft. dut.	1,731,030	849,121	2,737,447	1,831,230	7,953,271	3,668,852	22,310,942	13,474,964
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft. dut.	248,201	52,286	161,901	30,188	[2]248,201	[2]52,286	1,893,172	321,746
Containers—bottles, vials, etc. dut.	.....	31,936	.....	6,219	.....	252,820	.....	175,325
Table and kitchen utensils, lbs. dut.	120,383	51,420	179,709	35,159	[2]120,383	[2]51,420	522,359	133,148
Glassware, cut or decorated, lbs. dut.	360,542	148,897	432,513	174,615	.....	1,822,087	3,199,915	1,193,232
Blown glassware, n. e. s., lbs. dut.	658,249	162,847	847,413	215,992	[2]658,249	[2]162,847	5,320,682	1,166,534
Other glassware { free	.....	.....	.....	.....	[1]126,421	[1]106,800	.....	.....
Other glassware { dut.	.....	306,085	.....	190,635	.....	2,655,467	.....	1,926,266

[1]Jan. 1 to Sept. 21. [2]Sept. 22 to Oct. 31.